1093

HEALTH AND ENVIRONMENTAL ASSESSMENT
HAZARDOUS WASTE STORAGE TANKS

HANGAR 1000 TANK SYSTEM CLOSURE
NAVAL AIR STATION
JACKSONVILLE, FLORIDA

CLEAN - DISTRICT I
CONTRACT NO. N62467-89-D-0317

DECEMBER 1993

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

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December 1993

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
bls	below land surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CSF	cancer slope factor
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
ft/day	feet per day
G+G	Garver + Garver, Inc.
HEA	Health and Environmental Assessment
HEAST	Health Effect Assessment Summary Tables
HHEM	Human Health Evaluation Manual
HI	Hazard Index
IRIS	Integrated Risk Information System
kg	kilogram
ℓ	liter
ℓ/day	liters per day
LOAEL	lowest observed adverse effect level
MCL	Maximum Contaminant Levels
MCLG	Maximum Contaminant Limit Goal
mg	milligram
mg/kg	milligrams per kilogram
mg/ℓ	milligrams per liter
μg	microgram
μg/ℓ	microgram per liter
NAS	Naval Air Station
NGVD	National Geodetic Vertical Datum
NOAEL	no observed adverse effect level
OSWER	Office of Solid Waste and Emergency Response
PRG	Preliminary Remedial Goal
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	Reference Doses
RFI	RCRA Facility Investigation

GLOSSARY (Continued)

SAR	Site Assessment Report
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
USEPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), has prepared this Health and Environmental Assessment (HEA) for the Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) Contract Number N62467-89-D-0317, Contract Task Order 003. This document develops target soil and groundwater concentrations or Preliminary Remedial Goals (PRGs) based upon risks estimated from potential exposure to contaminants from the hazardous waste storage tank system in the Hangar 1000 keyway at Naval Air Station (NAS) Jacksonville, Florida.

1.1 PURPOSE. The HEA was prepared in response to, and in accordance with, Consent Order No. 88-0738, issued October 4, 1988, and amended December 7, 1990, by the former Florida Department of Environmental Regulation (FDER) now the Florida Department of Environmental Protection (FDEP). The Consent Order amendment allows the facility to pursue a risk-based clean closure of the Hangar 1000 underground storage tanks with a December 1, 1993, deadline. As part of the risk-based clean closure, this HEA was performed using recent and historical analytical data, current toxicity data on the chemicals identified at the site, and applicable health and environmental criteria. The goal of the HEA is to provide an evaluative basis for achieving a clean closure or risk-based clean closure of the site (i.e., to establish acceptable target concentrations that would maintain potential exposures within acceptable risk levels).

A clean closure or risk-based clean closure of the facility will be achieved if: (1) no contaminants are detected, (2) contamination detected is within acceptable risk levels, or (3) the site is remediated to meet the criteria of (1) or (2). This HEA establishes a set of risk-based target soil concentrations for the site-related chemicals. Exposure to these chemical concentrations will not result in unacceptable health risks.

As stated in the Closure Plan, the site will be remediated by removing the tank system and adjacent contaminated soils. If the data obtained from the proposed additional soil and groundwater characterization described in the Closure Plan (ABB-ES, 1992a) are significantly different from those used to develop this HEA, the HEA may need to be modified to incorporate the new data.

1.2 TECHNICAL APPROACH. This HEA was conducted following U.S. Environmental Protection Agency (USEPA) and FDEP guidance. Sources of this guidance include: *Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Guidance* (USEPA, 1989d); *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (RAGS/HHEM) Parts A and B* (USEPA, 1989a; 1991b); *Risk Assessment Guidance for Superfund: Volume II, Environmental Evaluation Manual* (USEPA, 1989b); *Supplemental Region IV Risk Assessment Guidance* (USEPA, 1991f); the *Risk Assessment Guidelines for Non-Superfund Sites* (FDER, 1990); the *Exposure Factors Handbook* (USEPA, 1990a); the *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (USEPA, 1991a); and the *Superfund Exposure and Assessment Manual* (USEPA, 1988).

The HEA was conducted in two phases. In the first phase, potential exposure scenarios were developed based upon present and projected future uses of the

site. In the second phase of the HEA, these scenarios were used to develop chemical-specific risk-based target soil and groundwater concentrations for evaluating requirements for remedial activity at the site. The target soil concentrations, or PRGs, are soil concentration levels considered to be protective of human health against contaminant exposure.

A habitat-based quantitative environmental assessment was not conducted because contaminant exposure of ecological receptors is considered minimal. The site is in an industrial area located in the keyway of the Hangar. The site is paved and is surrounded by paved areas used for parking vehicles and maintaining aircraft. The asphalt and concrete cover precludes any exposure of ecological receptors to subsurface soil contaminants. No surface soil is exposed at this site. Biotic receptors, including terrestrial and aquatic fauna, may be found at the NAS; however, their current or future presence in the Hangar 1000 area would be unlikely due to activities along the flightline, the lack of natural cover, and lack of food resources. Therefore, this site was not considered to present a risk to ecological receptors.

2.0 PHYSICAL SETTING

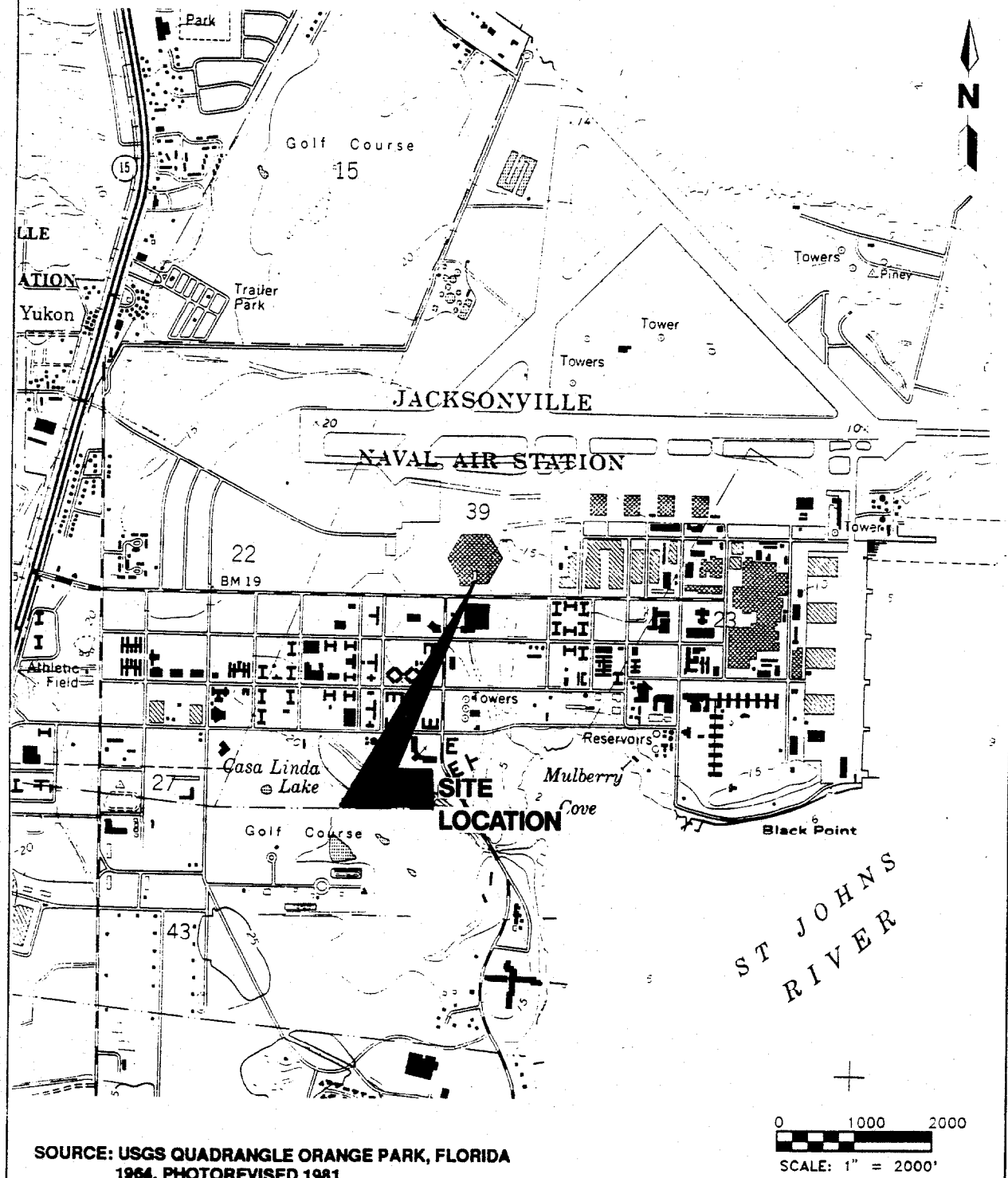
The site is located in an area described as the keyway of Hangar 1000, NAS Jacksonville, Duval County, Florida. The Hangar 1000 complex and the keyway are shown in Figures 2-1 through 2-3. The site is located in Section 39, Township 3 South, Range 27 East, at Latitude 30°13'34" North and Longitude 81°40'58" West, as shown on the U.S. Geological Survey 7.5-Minute Quadrangle map for Orange Park, Florida. The St. Johns River (approximately 1 mile east of Hangar 1000) forms the eastern border of NAS Jacksonville. It is a major water body that flows north and discharges into the Atlantic Ocean northeast of NAS Jacksonville. Stormwater from the site passes through a series of inlets and pipes into a drainage ditch, approximately 700 feet to the southeast, and eventually flows into the Mulberry Cove portion of the St. Johns River. Ground elevations at the site are approximately 15 feet above the National Geodetic Vertical Datum (NGVD) of 1929.

The site consists of two underground tanks, designated A and B, and the associated pipes under the keyway (Figure 2-3). The site is completely covered by a cement sidewalk. South of the Hangar is a parking area with a narrow grassy median between the parking area and the nearest road, Yorktown Avenue. The soil beneath the tanks is primarily a light grey and brown sand. The sand is very fine grained and well sorted with occasional clay lenses. A complete description of the soils can be found in the Site Assessment Report (SAR) and Closure Plan for this site (ABB-ES, 1992b; 1992a).

Groundwater from the surficial aquifer at the site is classified as G-II by the FDER. The water table of the surficial aquifer system is approximately 5 to 8 feet below land surface (bls). The surficial aquifer reportedly extends to a depth of approximately 25 to 30 feet bls. The aquifer soils are comprised of unconsolidated sands, with varying amounts of silt and clay (Geraghty & Miller, Inc., 1985). The direction of the groundwater flow in the surficial aquifer is southeast toward the St. Johns River with an estimated groundwater seepage velocity of 0.029 foot per day (ft/day) (ABB-ES, 1992b). Currently, the surficial aquifer in the NAS Jacksonville area is not used for domestic, potable, or industrial purposes. The base is supplied with drinking and industrial water by a series of wells installed into the Floridan aquifer system. A complete description of the site hydrogeology is in the SAR (ABB-ES, 1992b).

2.1 SITE HISTORY. Hangar 1000 is part of a complex that services large aircraft at NAS Jacksonville. Underground Tanks A and B were constructed as part of segment six of Hangar 1000 in the late 1960's and early 1970's. They were designed to receive the waste organic solvents and other substances associated with cleaning operations performed at the washrack within the hangar. Tank A may have also received wastes flowing into a manhole from other cleaning operations.

Tank A is a set of two concrete tanks with combined capacity of 750 gallons that are used as a solvent-water separator. Tank B is a 2,000-gallon steel storage tank. Tank A is connected to Tank B via metal piping. The washrack is a shallow grated sump inside Hangar 1000. A manhole approximately 4 feet deep connects the washrack to Tank A via metal piping. The drain lines to the tanks were plugged or capped in November 1987 and have not been used since that time. Stormwater



SOURCE: USGS QUADRANGLE ORANGE PARK, FLORIDA 1964, PHOTOREVISED 1981.

FIGURE 2-1
HANGAR 1000
SITE LOCATION MAP

HANGAR 1000
HEALTH AND
ENVIRONMENTAL
ASSESSMENT REPORT
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

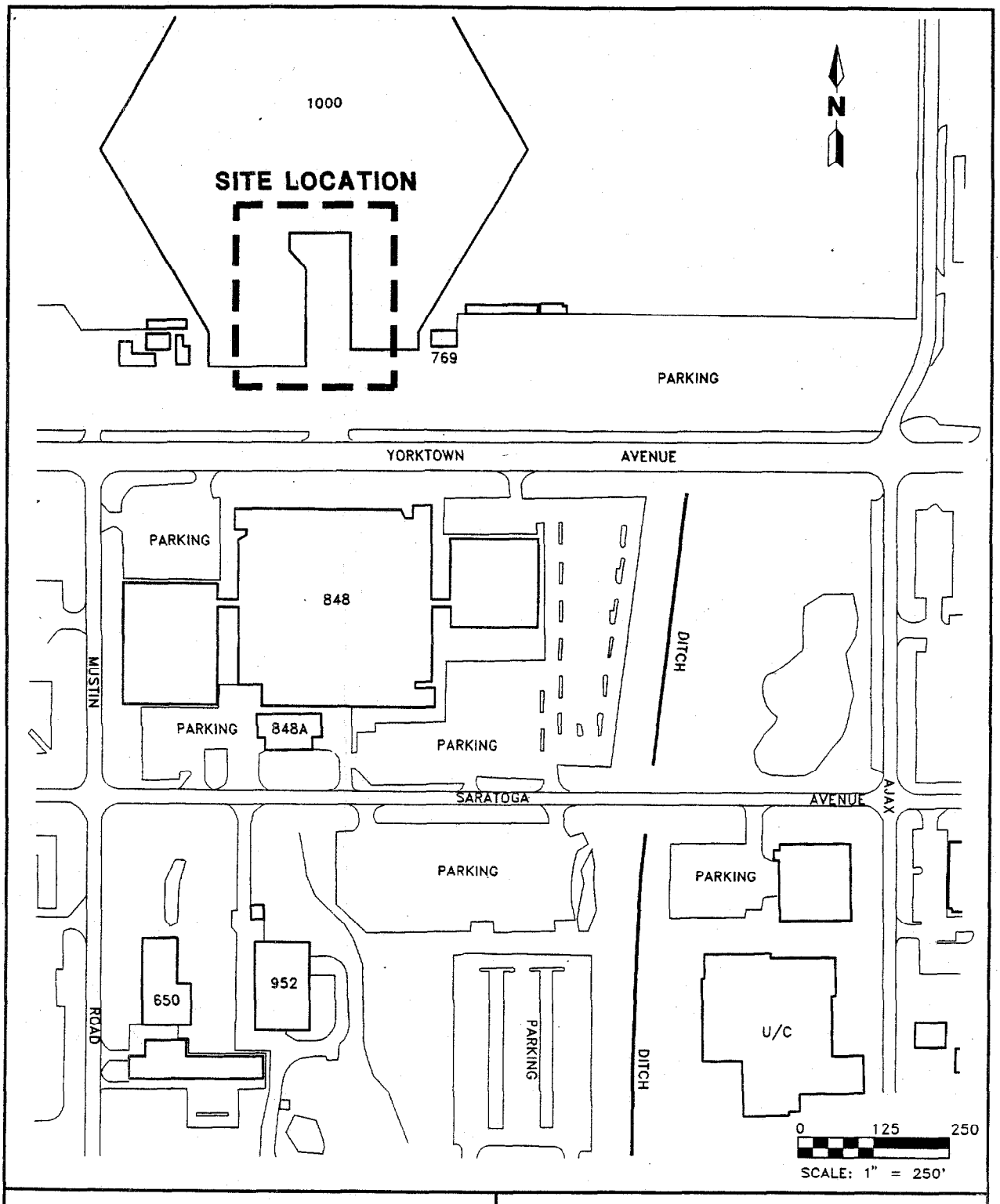


FIGURE 2-2
HANGAR 1000
SITE VICINITY MAP

HANGAR 1000
HEALTH AND
ENVIRONMENTAL
ASSESSMENT REPORT
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

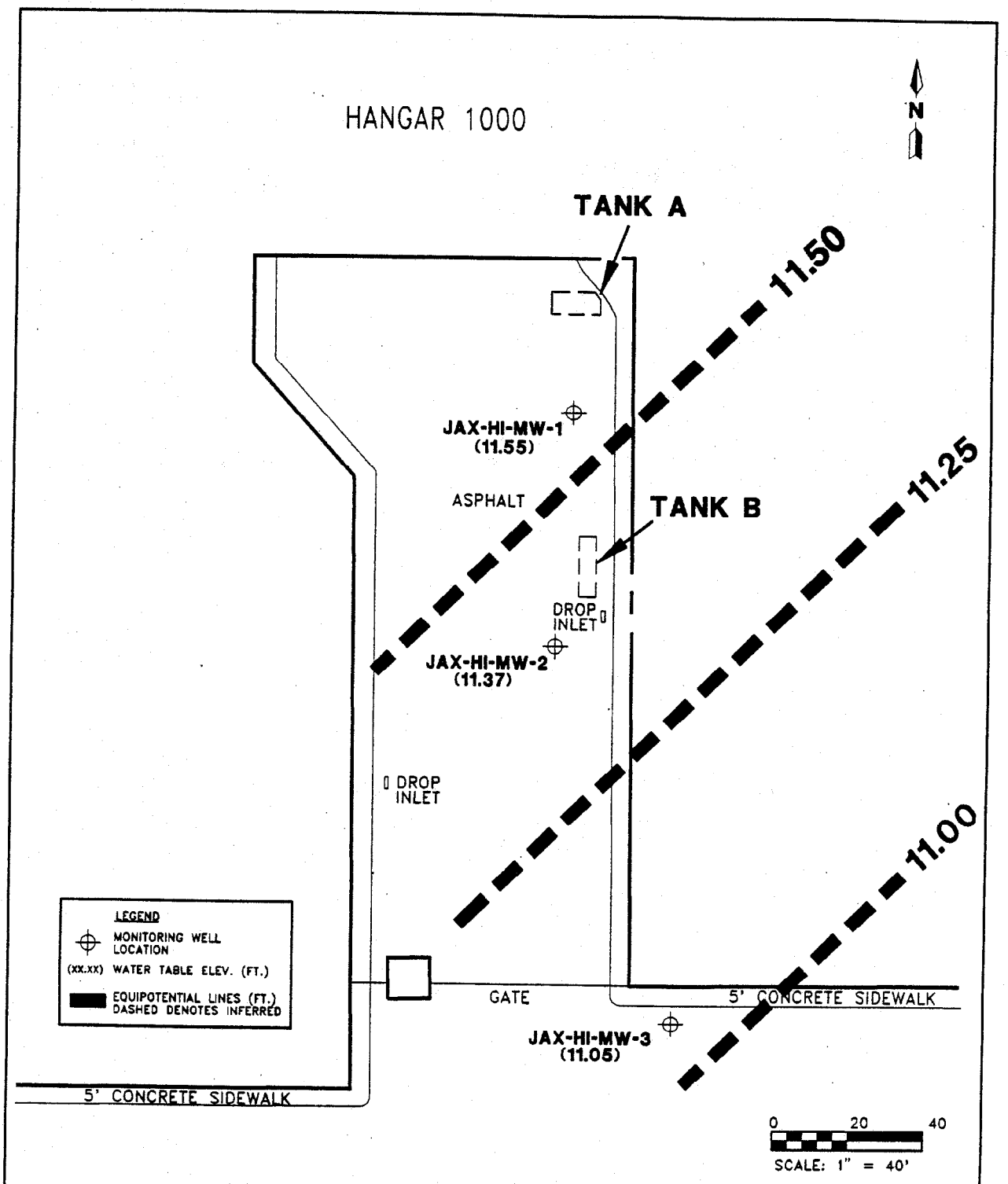


FIGURE 2-3

HANGAR 1000
WATER TABLE CONTOUR MAP
OCTOBER 21, 1991

HANGAR 1000
HEALTH AND
ENVIRONMENTAL
ASSESSMENT REPORT
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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runoff can still accumulate in Tank A because rainwater from a nearby 20-inch drain can surcharge through a 4-inch overflow line into Tank A during periods of heavy rain. Regular inspections are performed and accumulated rainwater is pumped out of the tanks as necessary. The SAR and Closure Plan contain details of the construction and location of these tanks (ABB-ES, 1992b; 1992a).

On June 21, 1988, the FDER conducted a hazardous waste inspection of the NAS Jacksonville facility. As a result of the inspection, FDER issued Warning Notice No. HW-16-0013 to NAS Jacksonville on July 22, 1988. All the alleged violations were corrected except 40 Code of Federal Regulations (CFR), Part 265.195 (tank inspection) and Part 265.197 (tank closure and post-closure). FDER and NAS Jacksonville agreed to enter into a Consent Order (No. 88-0738) to allow NAS Jacksonville time to prepare a closure plan and to perform the closure. The Consent Order stated that if contaminated soils could not be practically removed or decontaminated pursuant to 40 CFR 265.197(a), then NAS Jacksonville must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills (40 CFR 265.310).

Closure plans were submitted and initial sampling was performed as described below. The closure completion deadline was extended to allow the collection of sufficient data to determine risk-based target concentrations. The goal of the risk-based clean closure plan is to remove or treat all soils and groundwater containing contaminants above the target concentrations so that there is no unacceptable residual risk associated with the remaining soils or groundwater.

2.2 PREVIOUS INVESTIGATIONS. Garver + Garver, Inc. (G+G), was contracted to collect soil samples and provide data to support a clean closure of the tanks. G+G performed two rounds of sampling and analysis in January and May 1990. Volatile halogenated organic solvents, aromatic hydrocarbons, and other organic chemicals were detected in the soils around the tanks. Chromium, cadmium, barium, and lead were also detected in the soil; however, chromium, barium, and lead were detected within their naturally occurring background concentrations. Cadmium was detected above the naturally occurring background concentration (Kabata-Pendias and Pendias, 1992; Shacklette and Boerngen, 1984). A summary of the potentially site-related chemicals detected in the soils is shown in Table 2-1. Table 2-2 provides a comparison of the metal concentrations detected in the soils at the site with naturally occurring background concentrations.

FDER and NAS Jacksonville agreed that the Navy should perform additional investigations to assess potential contamination in the shallow groundwater at the site. They also agreed to determine if any contamination detected in the groundwater poses an unacceptable level of risk to human health or the environment. On December 7, 1990, FDER extended the tank closure completion deadline to December 1, 1993, to allow time for revision to the Closure Plan, further investigation, development of an HEA, and closure action, as necessary.

In January 1991, ABB-ES conducted a preliminary hydrogeologic assessment of the site. ABB-ES installed eight temporary shallow piezometers, surveyed piezometer casing elevations, and measured groundwater elevations. In October 1991, ABB-ES collected soil for analysis and installed four monitoring wells. Groundwater was sampled in October and December 1991, and the results are also included in Table 2-1. A full discussion of the Hangar 1000 site and the chemical contaminants, both soil and groundwater, can be found in the SAR (ABB-ES, 1992b).

Table 2-1
Maximum Concentrations of Chemicals
Detected in the Soil and Groundwater

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

	Maximum Concentration		Source
Groundwater organic chemicals	**(µg/ℓ)**	**(mg/ℓ)**	
Acetone	15	0.015	A
Di-n-butyl phthalate	1	0.001	A
Chloroform	14	0.014	A
1,1-Dichloroethane	51	0.051	A
1-1-Dichloroethene	43	0.043	A
cis,trans-1,2-Dichloroethene	43	0.043	A
Tetrachloroethene	7	0.007	A
1,1,1-Trichloroethane	330	0.330	A
Trichloroethene	320	0.320	A
Groundwater metals	**(mg/ℓ)**		
Barium	0.199		A
Chromium (total)	0.0263		A
Lead	0.0081		A
Soil organic chemicals	**(µg/kg)**	**(mg/kg)**	
Acetone	5,200	5.200	A
bis(2-Ethylhexyl)phthalate	995	0.995	G
Carbon tetrachloride	18	0.018	A
1,1-Dichloroethane	1,850	1.850	G
1,1-Dichloroethene	1,883	1.883	G
Ethylbenzene	2,000	2.000	G
Methylene chloride	2,000	2.000	G
Naphthalene	1,040	1.040	G
Tetrachloroethene	31,450	31.450	G
Toluene	11,350	11.350	G
1,1,1-Trichloroethane	52,000	52.000	G
Trichloroethene	6,300	6.300	G
Trichlorotrifluoroethane	783	0.783	G
Xylene	14,750	14.750	G
Soil metals	**(mg/kg)**		
Barium	55.8		G
Cadmium	25.3		G
Chromium (total)	9.13		G
Lead	9.55		G

Notes: µg/ℓ = micrograms per liter.
mg/ℓ = milligrams per liter.
µg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
A = maximum concentration derived from ABB-ES samples.
G = maximum concentration derived from Garver + Garver samples.

Table 2-2
Comparison of Detected Soil Metal Concentrations With Naturally Occurring Background Ranges

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

Element	Maximum Concentration[1] Detected (mg/kg)	Range Near Jacksonville[2] (mg/kg)	Range for Sandy Soils[3] (mg/kg)
Barium	55.8	10 to 200	10 to 1,500
Cadmium	25.3	NA	0.08 to 0.47
Chromium (total)	9.13	1 to 20	3 to 200
Lead	9.55	<10	<10 to 70

[1] Source: Garver + Garver, 1991.
[2] Source: Shacklette and Boerngen, 1984.
[3] Source: Kabata-Pendias and Pendias, 1992.

Notes: mg/kg = milligram per kilogram.
NA = not available.

2.3 MEDIA OF CONCERN AND MIGRATION ROUTES. All potentially site-related chemicals detected in soil and groundwater at Hangar 1000 are presented in Table 2-1. The table includes unvalidated chemical data from previous investigations (G+G) and validated data from the 1991 ABB-ES investigations. All the chemicals detected in all investigations have been considered in developing the target soil concentrations.

The soil appears to be more contaminated than the groundwater, but chemicals in the soils may have migrated into the groundwater. Because the tank system is located at least partly below the water table, it is possible that chemicals leaking from the tanks could have also entered the groundwater directly. Removing the tank system and the contaminated soils will prevent any further contamination of either the soil or the groundwater.

The chemicals detected were primarily volatile organic solvents and some metals. Metal concentrations detected in the soils were compared to typical sandy soil and regional background concentrations to determine site-related contaminants. The four identified potential metals of concern are cadmium, chromium, lead, and barium. Cadmium, chromium, and lead are all possible hazardous substances that may be present in wastes expected from cleaning operations of metals used in aircraft. These may have been disposed of, along with the solvent wastes, into the tanks. Barium has been used as a lubricating oil additive and, therefore, also may have been present in the waste cleaning solvents. According to the literature for trace metals in the soils of the United States (Kabata-Pendias and Pendias, 1992; Shacklette and Boerngen, 1984), the chromium, lead, and barium concentrations observed are all within the normal background ranges. The maximum cadmium concentration is above the concentration range expected for background.

2.4 HUMAN AND ENVIRONMENTAL RECEPTORS. Hangar 1000 is part of the flightline support and industrial services at NAS Jacksonville. The hangar services a large aircraft runway. The area surrounding the hangar and keyway is paved with concrete and asphalt. The keyway entrance has a tall, locked gate so that only employees requiring access are permitted to go into the keyway area. Currently, the human population potentially exposed to the contamination at Hangar 1000 is limited to base personnel assigned to Hangar 1000. There are no plans to close the base or discontinue flightline services near Hangar 1000. Under a reasonable future land use, the area is expected to remain a hangar, and industrial military operations involving aircraft service are expected to continue. Future receptors will continue to be base personnel assigned to activities in Hangar 1000.

As discussed in Section 1.0, environmental receptors are not expected to be present in the vicinity of Hangar 1000.

2.5 HEALTH AND ENVIRONMENTAL CRITERIA. The two media of concern at Hangar 1000 are soil and groundwater. The purpose of this section is to identify any regulations, standards, or criteria that are potentially applicable or relevant to establishing action levels for closure of Hangar 1000. Applicability of the criteria to risk-based clean closure for current and future industrial land use is also addressed.

Soils. There are no general Florida or USEPA Region IV standards for soil quality. Florida does have criteria applicable to petroleum-contaminated soils that have been remediated using thermal treatment. According to Chapter 17-775, Florida Administrative Code (FAC), these criteria "apply only to thermal treatment facilities and the contaminated soils which will be treated therein." The criteria are not applicable if soil may be classified as a hazardous waste or contains hazardous waste, i.e., the soil cannot be treated thermally if suspected of containing a hazardous waste. Hazardous wastes include soils containing volatile organic halogens. Appendix A (Table A-1) contains these thermal treatment soil criteria for reference. Although these criteria do not specifically apply because the tanks and soils potentially contain hazardous waste, they do provide guidance for soil levels that are considered "clean" under this State regulation.

The expected future land use at this site is considered to be industrial. The proposed rule for Corrective Actions under RCRA developed by USEPA contains examples of concentrations meeting criteria for action levels (USEPA, 1990c). These concentrations are based on an exposure assuming residential land use, long-term direct contact with soils, and soil ingestion by children. It is applicable to the conditions of unrestricted land use. For reference, the chemicals and the concentrations derived by USEPA under these assumptions, using toxicity data as of July 27, 1990, are given in Appendix B.

USEPA Region III (USEPA, 1993a) has derived a set of risk-based media concentrations that may be used as a screening tool for Superfund sites. USEPA Region IV has previously accepted this screening approach. These concentrations are based on exposure to surface soil under residential or worker scenarios. Region III's risk-based concentrations for chemicals detected in the subsurface soil at Hangar 1000 are summarized in Table A-2 and the entire USEPA memorandum is attached in Appendix B.

Groundwater. The groundwater is expected to migrate slowly from the site and eventually enter the St. Johns River. Currently, the groundwater from the surficial aquifer under the site is not used for any purpose. Due to the nature of the industrial complex surrounding the site, it is unlikely that groundwater would be used in the future. However, if the groundwater were to be used in the future, it would probably be for industrial purposes. According to calculations presented in the SAR for estimating aquifer production rates, the amount of water expected to be produced by the shallow aquifer is less than 3 gallons per minute for a 6-inch diameter well (ABB-ES, 1992b).

There are no published or promulgated criteria for industrial water use. FDER and USEPA consider situations where the only expected water use is industrial on a case by case basis. As previously indicated, no likely use, or at most limited industrial use only, is probable for the surficial aquifer at Hangar 1000. Despite the low probability of groundwater use as a drinking water source, the drinking water regulations and general regulations have been included for reference in the health and environmental criteria.

Water Quality Standards for Florida are promulgated as Chapter 17-3, FAC. Part IV, Water Quality Criteria--Groundwater, provides classifications and standards for Florida groundwater. Groundwater in the surficial aquifer at Hangar 1000 meets the classification G-II (Chapter 17-3.403, FAC). The Quality Standards for Class G-II waters are the minimum standards for all groundwaters (Chapter 17-3-402, FAC). The primary and secondary drinking water quality standards are listed in Chapters 17-550.310 and 17-550.320, FAC. The minimum standards require that no concentrations of deleterious or hazardous substances be present that represent a serious danger to public health or impair the beneficial use of adjacent waters. Florida's Primary Drinking Water Standards Maximum Contaminant Levels (MCLs) (Chapter 17-550.310, FAC, January 3, 1991) were reviewed and these concentrations for the chemicals detected in the groundwater at Hangar 1000 are listed in Appendix A, Table A-3. The current Federal Drinking Water Regulations and Health Advisories (USEPA, May 1993); USEPA, 1993b) were also reviewed and the pertinent MCLs and Maximum Contaminant Level Goals (MCLGs) for the chemicals detected in the groundwater at Hangar 1000 are also listed in Appendix A, Table A-3.

Consistent with the industrial land use at Hangar 1000, exposure to contaminated groundwater from the surficial aquifer is considered only for industrial use. In doing so, the groundwater is assumed to be used only in nonpotable applications.

3.0 DEVELOPMENT OF TARGET CONCENTRATIONS

This section describes the methodology and rationale for developing target concentrations of site-related chemicals of concern at Hangar 1000. These target concentrations provide adequate protection of both human health and the environment. They will be used to determine the need for and effectiveness of various remedial actions. Based on the results of the SAR (ABB-ES, 1992b), the media of concern at Hangar 1000 are soils and groundwater. Air is not considered a medium of concern because the contamination is limited to subsurface soils and the soils are effectively capped with asphalt and concrete.

Soil and groundwater target concentrations are derived to provide a prescribed level of protection against potential exposures to site-related chemicals based on current and assumed future land use. By setting the total risk at a specified level and defining likely exposure conditions it is possible to derive target soil and groundwater concentrations. These concentrations are the proposed target soil and groundwater concentrations that are protective of human health.

The following subsections describe the potentially exposed populations and current and assumed land uses at Hangar 1000 (Subsection 3.1) and toxicity information (Subsection 3.2) used to derive the risk-based target concentrations. These target concentrations are presented in Subsection 3.3.

3.1 EXPOSURE ASSESSMENT. The objective of the exposure assessment is to estimate the type and magnitude of potential exposure to site-related chemicals. This section summarizes the site-related chemicals in each media, current and potential future land use, potentially exposed populations, and current and possible future exposure pathways. This information is combined with appropriate toxicity information to develop risk-based target concentrations.

The exposure assessment was developed based on current USEPA methodology and guidance (USEPA, 1989b; 1991a; 1991b). These documents provide standard exposure scenarios and default values for many exposure parameters that were used in this exposure assessment. Values for site-specific exposure parameters, not included in these guidance documents, were selected using best professional judgment and knowledge of expected current and future land use at Hangar 1000.

3.1.1 Identification of Site Contaminants A variety of halogenated and non-halogenated organic chemicals and metals were detected in the subsurface soils and groundwater at Hangar 1000. A discussion of the analytical results, nature, and magnitude of contamination at this site is presented in the SAR (ABB-ES, 1992b). All chemicals detected in at least one sample, and not attributed to naturally occurring elements, were considered to be site related and evaluated in this exposure assessment.

Although the maximum cadmium concentration (25.3 milligrams per kilogram [mg/kg]) is above the background concentration, it is less than the Chapter 17-775.400, FAC, clean soil criterion of 55 mg/kg. Of the metals, only cadmium exceeded the normal background ranges (Table 2-2). As noted in Section 2.5, these clean soil criteria do not apply to hazardous waste, but they do provide a basis for deciding if soil containing cadmium can be regarded as clean. Additionally, the maximum cadmium concentration is below the Region III worker soil ingestion

scenario screening concentration of 510 mg/kg (USEPA, 1992b) and below the RCRA action level of 40 mg/kg (USEPA, 1990c). These soil concentrations are associated with a non-carcinogenic hazard index of 1.0 for industrial soil exposures. Cadmium soil concentrations detected are well below the hazard index of 1.0, which is the usual target for cleanups. (See Appendix B.) Therefore, cadmium is not considered a site contaminant and is not further evaluated in the HEA.

None of the metals detected in groundwater were found at levels above Florida MCLs for each metal and, as such, were not included in the HEA. The remaining chemicals considered in the HEA are listed in Table 3-1.

3.1.2 Routes of Exposure Hangar 1000 is part of the flightline support and industrial services at NAS Jacksonville. It is located south of the runways and adjacent to other flightline industrial facilities. The hangar is currently operational and services a large aircraft runway. The future land use is expected to remain the same. The site is entirely covered by asphalt and cement with no current or regularly scheduled maintenance activities that penetrate the surface.

Groundwater in the surficial aquifer beneath Hangar 1000 is not used for domestic or potable purposes. It is not likely to be used in the future, because this area of the NAS is already serviced by wells tapping the Floridan aquifer. Also, as further discussed in Subsection 3.1.2.2, the surficial aquifer is capable of providing only minimal quantities of water. This factor precludes its practical use as a water supply.

Base employees assigned to Hangar 1000 are considered the potential receptors of contaminant exposure. However, given the industrial nature of the site, exposure is considered to be minimal and limited to possible future invasive maintenance or construction activities such as utility line installation or repairs. Therefore, based on current land use at Hangar 1000, there is no exposure to either subsurface soil or groundwater contaminants.

Future potential exposure to residual contamination at Hangar 1000 is possible through four exposure pathways: (1) inhalation of both soil particulates and volatiles released from the soil, (2) incidental ingestion of soil, (3) dermal contact with subsurface soils, and (4) dermal contact with groundwater. USEPA has provided guidance for quantitatively evaluating these exposure pathways. The guidance and equations used to estimate contaminant intake for each exposure pathway are described in the following subsections.

3.1.2.1 **Exposure to Soils** The potential for exposure to contaminated soils at this site is considered to be minimal. The entire site is covered with asphalt and cement, and employee activities do not involve contact with subsurface soils. Because site activities will be related to aircraft maintenance, it is unlikely that the asphalt or cement would ever be removed. The only reasonable future exposure to subsurface contaminants is a result of invasive activities such as utility construction, maintenance, or repair. The most likely future maximum exposure conditions at this site may occur as a result of the following action.

- An employee excavating within the Hangar 1000 area is exposed to subsurface soil contaminants through incidental ingestion of the soil, dermal contact with the soil, or inhalation of contaminated soil particles and volatiles released from the soil. Because exposure is limited

Table 3-1
Maximum Concentrations in Soil and Groundwater of Site-related Chemicals in the Health and Environmental Assessment (HEA)

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

	Maximum Concentration		Source
Groundwater organics	**(µg/ℓ)**	**(mg/ℓ)**	
Acetone	15	0.015	A
Di-n-butylphthalate	1	0.001	A
Chloroform	14	0.014	A
1,1-Dichloroethane	51	0.051	A
1-1-Dichloroethene	43	0.043	A
cis,trans-1,2-Dichloroethene	43	0.043	A
Tetrachloroethene	7	0.007	A
1,1,1-Trichloroethane	330	0.330	A
Trichloroethene	320	0.320	A
Soil organics	**(µg/kg)**	**(mg/kg)**	
Acetone	5,200	5.2	A
bis(2-Ethylhexyl)phthalate	955	0.955	G
Carbon tetrachloride	18	0.018	A
1,1-Dichloroethane	1,850	1.850	G
1,1-Dichloroethene	1,883	1.883	G
Ethylbenzene	2,000	2.000	G
Methylene chloride	2,000	2.000	G
Naphthalene	1,040	1.040	G
Tetrachloroethene	31,450	31.450	G
Toluene	11,350	11.350	G
1,1,1-Trichloroethane	52,000	52.000	G
Trichloroethene	6,300	6.300	G
Trichlorotrifluoroethane	783	0.783	G
Xylenes (mixed)	14,750	14.750	G

Notes: µg/ℓ = micrograms per liter.
mg/ℓ = milligrams per liter.
µg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
A = maximum concentration derived from ABB-ES samples.
G = maximum concentration derived from Garver + Garver samples.

to excavation and repair work, a 30-day exposure frequency (i.e., 5 days per week for 6 weeks) is assumed.

The assumptions used to evaluate inhalation, ingestion, and dermal contact to subsurface soils, as well as inhalation of volatiles released from soils, are consistent with recent USEPA guidance (USEPA, 1991a; 1991b). The equations used to estimate soil target chemical concentrations are presented in Table 3-2. Values for each parameter are presented in Table 3-3 with the appropriate reference. It should be noted that these equations assume that every exposure is to the most highly contaminated soils, i.e., 100 percent of the daily intake of the results from exposure to these soils. No adjustment to the frequency of contact has been made to account for the portion of the site that is not contaminated. Therefore, these equations represent the upper-bound or most conservative estimate of exposure, and the actual exposure is likely to be much less.

3.1.2.2 **Exposure to Groundwater** There is no current exposure to groundwater from the surficial aquifer. In addition, future use of groundwater is considered highly unlikely because of the very low water yield characteristics of the surficial aquifer. A single 6-inch diameter well, with 10 feet of drawdown, would produce a sustained water yield of less than 3 gallons per minute (calculations based on the Theis equation as referenced in the SAR using a transmissivity of 374 gallons per day per foot, a storativity of 0.25, and a pumping duration of 30 days) (ABB-ES, 1992b). Based on these values, the surficial aquifer does not have sufficient capacity to support a production well for practical industrial water use, even if multiple wells were used.

If the aquifer were put to limited use, however, it is possible that human contact with groundwater could occur if the groundwater were to be used for a purposes, such as for wash water. The following reasonable maximum likely exposure scenario was developed to address this potential pathway.

- A long-term employee is exposed to contaminated groundwater while washing his hands or other objects. The assumed contact occurs four times per day with each washing episode lasting 5 minutes. The total contact time with the contaminated groundwater is 20 minutes per day.

The USEPA has provided guidance for quantitatively evaluating this exposure pathway. The amount of a chemical absorbed via dermal contact with contaminated groundwater is a function of the skin surface area, chemical-specific dermal permeability constant, and the chemical concentration in water. The equation used to estimate groundwater target concentration from this route of exposure is presented in Table 3-2. Values for each exposure parameter are presented in Table 3-3. Soil-to-air volatilization factors calculated for volatile chemicals and the chemical-specific physical constants used are presented in Table 3-4.

3.2 TOXICITY ASSESSMENT. This toxicity assessment provides information regarding the potential for a specific contaminant to cause adverse effects in humans. It also characterizes the relationship between the dose of that chemical

Table 3-2
Equations Used To Calculate Soil and Groundwater Target Concentrations

Health and Environmental Assessment
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Soil target concentrations based upon carcinogenic effects:

$$C_{soil} = \frac{TR \times BW \times AT \times 365\ days/year}{EF \times ED \times [(SF_o \times 10^{-6} \times (IR_{soil} + (SA \times AF \times ABS)) + (SF_i \times IR_{air} \times (\frac{1}{VF} + \frac{1}{PEF}))]}$$

where,

C_{soil}	target chemical soil concentration (mg/kg),
TR	target excess individual lifetime cancer risk (unitless),
BW	body weight (kg),
AT	averaging time (yr),
EF	exposure frequency (days/yr),
ED	exposure duration (yr),
SF_o	oral cancer slope factor $(mg/kg/day)^{-1}$,
CF	conversion factor (10^{-6} kg/mg),
SA	exposed skin surface area (cm^2),
AF	soil adherence factor (mg/cm^2),
ABS	skin absorption (%),
IR_{soil}	soil ingestion rate (mg/day),
SF_i	inhalation cancer slope factor $(mg/kg/day)^{-1}$,
IR_{air}	worker inhalation (m^3/day),
VF	soil to air volatilization factor, and
PEF	particulate emission factor.

Soil target concentrations based upon non-carcinogenic effects:

$$C_{soil} = \frac{THI \times BW \times AT \times 365\ days/year}{EF \times ED \times [((\frac{1}{RFD_o}) \times 10^{-6} \times (IR_{soil} + (SA \times AF \times ABS))) + (\frac{1}{RfD_i} \times IR_{air} \times (\frac{1}{VF} + \frac{1}{PEF}))]}$$

where,

C_{soil}	target chemical soil concentration (mg/kg),
THI	total hazard index (unitless),
BW	body weight (kg),
AT	averaging time (yr),
EF	exposure frequency (days/yr),
ED	exposure duration (yr),
RfD_o	oral reference dose (mg/kg),
CF	conversion factor (10^{-6} kg/mg),
SA	exposed skin surface area (cm^2),
AF	soil adherence factor (mg/cm^2),
ABS	skin absorption (%),
IR_{soil}	soil ingestion rate (mg/day),
RfDi	inhalation reference dose (mg/kg),
IR_{air}	worker inhalation (m^3/day),
VF	soil to air volatilization factor, and
PEF	particulate emission factor.

See notes at end of table.

Table 3-2 (Continued)
Equations Used To Calculate Soil and Groundwater Target Concentrations

Health and Environmental Assessment
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Soil to air volatilization factors:

$$VF = \frac{LS \times V \times DH}{A} \times \frac{(3.14 \times \alpha \times T)^{\frac{1}{2}}}{(2 \times D_{ei} \times E \times K_{as} \times 10^{-3} kg/g)}$$

$$\alpha\,(cm^2/s) = \frac{D_{ei} \times E}{E + (p_s)\,(1-E)\,/\,K_{as}}$$

where,

VF	volatilization factor (m^3/kg),
LS	length of side of contaminated Area (m),
V	wind Speed in mixing zone (m/s),
DH	diffusion height (m),
A	area of contamination (cm^2),
D_{ei}	effective diffusivity (cm^2/s),
E	true soil porosity (unitless),
K_{as}	soil to air partition coefficient (g soil/cm^3 air),
p_s	true soil density or particulate density (g/cm^3), and
T	exposure interval (s).

Water target concentrations based upon carcinogenic effects:

$$C_{water} = \frac{TR \times BW \times AT \times 365\ days/year}{EF \times ED \times ET \times [SF_O] \times PC \times 10^{-6} \times SA}$$

where,

C_{water}	target chemical water concentration ($\mu g/\ell$),
TR	target excess individual lifetime cancer risk (unitless),
BW	body weight (kg),
AT	averaging time (yr),
EF	exposure frequency (days/yr),
ED	exposure duration (yr),
ET	exposure time (min/day),
SF_o	oral cancer slope factor $(mg/kg/day)^{-1}$,
CF	conversion factor (10^{-6} mg • $\ell/\mu g$ • cm^3),
SA	exposed skin surface area (cm^2), and
PC	chemical specific dermal permeability constant (cm/hr).

See notes at end of table.

Table 3-2 (Continued)
Equations Used To Calculate Soil and Groundwater Target Concentrations

Health and Environmental Assessment
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Water target concentrations based upon non-carcinogenic effects:

$$C_{water} = \frac{THI \times BW \times AT \times 365\ days/year}{EF \times ED \times ET \times \left[\frac{1}{RfD_o}\right] \times PC \times 10^{-6} \times SA}$$

where,

C_{water}	target chemical water concentration ($\mu g/\ell$),
THI	target hazard index (unitless),
BW	body weight (kg),
AT	averaging time (yr),
EF	exposure frequency (days/yr),
ED	exposure duration (yr),
ET	exposure time (min/day),
RfD_o	oral reference dose (mg/kg/day),
CF	conversion factor (10^{-6} mg • $\ell/\mu g$ • cm^3),
SA	exposed skin surface area (cm^2), and
PC	chemical specific dermal permeability constant (cm/hr).

Notes:
- mg/kg = milligrams per kilogram.
- kg = kilogram.
- yr = year.
- days/yr = days per year.
- mg/kg/day = per milligram per kilogram per day.
- 10^{-6} kg/mg = $1x10^{-6}$ kilograms per milligram.
- cm^2 = square centimeters.
- mg/cm^2 = milligrams per square centimeter.
- % = percent.
- mg/day = milligrams per day.
- m^3/day = cubic meters per day.
- m^3/kg = cubic meters per kilogram.
- m = meters.
- m/s = meters per second.
- cm^2/s = square centimeters per second.
- g soil/cm^3 air = grams of soil per cubic centimeter of air.
- g/cm^3 = grams per cubic centimeter.
- s = seconds.
- $\mu g/\ell$ = micrograms per liter.
- min/day = minutes per day.
- cm/hr = centimeters per hour.
- mg • $\ell/\mu g$ • cm^3 = milligram • liters per microgram • cubic centimeters.

Table 3-3
Exposure Parameters Used to Calculate Soil or Groundwater Target Concentrations

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Exposure Pathway	Definition (units)	Value Used in Calculations	Reference
C_{soil}	Target chemical concentration in soil.	Chemical specific	
TR	Target excess individual lifetime cancer risk (unitless).	10^{-6}.	USEPA, 1991b
BW	Body weight (kg)	70 kg	USEPA, 1991b
AT	Averaging time (yr)	70 yrs for carcinogens, 0.822 yrs for non-carcinogens in soil, 25 yrs for noncarcinogens in groundwater.	USEPA, 1991b
EF	Exposure frequency (days/yr).	30 days for soil, 250 days per year for groundwater.	Assumption
ET	Exposure time for groundwater.	0.33 hour per day	Assumption
ED	Exposure duration (yr)	1 yr for soil, 25 years for groundwater	Assumption
SF_o	Oral cancer slope factor $(mg/kg/day)^{-1}$.	Chemical specific	IRIS, 1993b
CF	Conversion factor	(10^{-6} kg/mg)	
SA	Exposed skin surface area (cm^2).	2,000 cm^2 for soil, 820 cm^2 for groundwater	USEPA, 1991b
AF	Soil adherence factor (mg/cm^2).	3.5 mg/cm^2	USEPA, 1991b
ABS	Skin absorption (%)	10% for organics, 1% for inorganics	FDER, 1991
IR_{soil}	Soil ingestion rate (mg/day)	480 mg/day	USEPA, 1991b
SF_i	Inhalation cancer slope factor $(mg/kg/day)^{-1}$.	Chemical specific	HEAST, 1993c
IR_{air}	Worker inhalation (m^3/day)	2.5 m^3/hr	USEPA, 1991b
VF	Soil to air volatilization factor.	Chemical specific	USEPA, 1991b
PEF	Particulate emission factor	Chemical specific	USEPA, 1991b
THI	Total hazard index	1	USEPA, 1991b
RfD_o	Oral reference dose (mg/kg).	Chemical specific	IRIS, 1993b
RfD_i	Inhalation reference dose (mg/kg).	Chemical specific	HEAST, 1993c
LS	Length of side of contaminated area (m).	10 m	Assumption

See notes at end of table.

Table 3-3 (Continued)
Exposure Parameters Used to Calculate Soil or Groundwater Target Concentrations

Health and Environmental Assessment
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Exposure Pathway	Definition (units)	Value Used in Calculations	Reference
V	Wind speed in mixing zone (m/s).	2.25 m/s	USEPA, 1991b
DH	Diffusion height (m)	2 m	USEPA, 1991b
A	Area of contamination (cm^2)	300,000 cm^2	Assumption
D_{ei}	Effective diffusivity (cm^2/s)	Chemical specific or $D_i \times E^{0.33}$	USEPA, 1988
E	True soil porosity (unitless)	0.35	USEPA, 1991b
K_{as}	Soil-to-air partition coefficient (g soil/cm^3 air).	Chemical specific or $(H/K_d) \times 41$	USEPA, 1988b
P_s	True soil density or particulate density (g/cm^3).	2.65 g/cm^3	USEPA, 1991b
T	Exposure interval (s).	7.9×10^8 s	USEPA, 1991b
D_i	Molecular diffusivity (cm^2/s)	Chemical specific	USEPA, 1986
H	Henry's law constant (atm-m^3/mol).	Chemical specific	USEPA, 1986
K_d	Soil to water partition coefficient (cm^3/g).	Chemical specific or $K_{oc} \times OC$	USEPA,1986
K_{oc}	Organic carbon partition coefficient (cm^3/g).	Chemical specific	USEPA, 1986
OC	Organic carbon content of soil.	2%	USEPA, 1991
PC	Chemical specific permeability constant (cm/hr).	Chemical specific	

Notes:
kg = kilograms.
yr = year.
day/yr = days per year.
mg/kg/day = milligrams per kilogram per day.
cm^2 = square centimeters.
mg/cm^2 = milligrams per square centimeter.
% = percent.
mg/day = milligrams per day.
m^3/day = cubic meters per day.
USEPA = U.S. Environmental Protection Agency.
FDER = Florida Department of Environmental Regulation.
mg/kg = milligrams per kilogram.
m = meters
m/s = meters per second.
cm^2/s = square centimeters per second.
g soil/cm^3 air = grams of soil per cubic centimeter of air.
s = seconds.
atm-m^3/mol = atmospheres-cubic meters per mole.
cm^3/g = cubic centimeters per gram.
cm/hr = centimeters per hour.
HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System.

Table 3-4
Chemical-Specific Data for Volatile Chemicals

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CAS #	Chemical Name	D_i (cm^2/s)	D_{ei} (cm^2/s)	H ($atm \cdot m^3/mol$)	K_{oc} (cm^3/g)	K_d (cm^3/g)	K_{as} (g soil/cm^3 air)	VF (kg/m^3)
67-64-1	Acetone	0.10616	0.07508	2.06×10^{-5}	2.2	4.4×10^{-2}	1.9×10^{-2}	$4.43 \times 10^{+4}$
71-43-2	Benzene	0.08969	0.06343	5.59×10^{-3}	83	$1.7 \times 10^{+0}$	1.4×10^{-1}	$1.77 \times 10^{+4}$
56-23-5	Carbon tetrachloride	0.08209	0.05805	2.41×10^{-2}	110	$2.2 \times 10^{+0}$	4.5×10^{-1}	$9.98 \times 10^{+3}$
67-66-3	Chloroform	0.09130	0.06457	2.87×10^{-3}	31	6.2×10^{-1}	1.9×10^{-1}	$1.49 \times 10^{+4}$
75-34-3	1,1-Dichloroethane	0.09174	0.06488	4.31×10^{-3}	30	6.0×10^{-1}	2.9×10^{-1}	$1.18 \times 10^{+4}$
107-06-2	1,2-Dichloroethane	0.09174	0.06488	9.78×10^{-4}	14	2.8×10^{-1}	1.4×10^{-1}	$1.72 \times 10^{+4}$
75-35-4	1,1-Dichloroethene	0.09387	0.06638	3.40×10^{-2}	65	$1.3 \times 10^{+0}$	$1.1 \times 10^{+0}$	$5.72 \times 10^{+3}$
540-59-0	1,2-Dichloroethene (cis)	0.09387	0.06638	7.58×10^{-3}	49	9.8×10^{-1}	3.2×10^{-1}	$1.12 \times 10^{+4}$
540-59-0	1,2-Dichloroethene (trans)	0.09387	0.06638	6.56×10^{-3}	59	$1.2 \times 10^{+0}$	2.3×10^{-1}	$1.34 \times 10^{+4}$
100-41-4	Ethylbenzene	0.07310	0.05170	6.43×10^{-3}	1,100	$2.2 \times 10^{+1}$	1.2×10^{-2}	$6.76 \times 10^{+4}$
75-09-2	Methylene chloride	0.10518	0.07439	2.03×10^{-3}	8.8	1.8×10^{-1}	4.7×10^{-1}	$8.58 \times 10^{+3}$
78-93-3	Methyl ethyl ketone	0.09212	0.06515	4.40×10^{-2}	4.5	9.0×10^{-2}	$2.0 \times 10^{+1}$	$6.54 \times 10^{+2}$
127-18-4	Tetrachloroethene	0.07626	0.05393	2.59×10^{-2}	364	$7.3 \times 10^{+0}$	1.5×10^{-1}	$1.87 \times 10^{+4}$
108-88-3	Toluene	0.08063	0.05702	6.73×10^{-3}	300	$6.0 \times 10^{+0}$	4.6×10^{-2}	$3.27 \times 10^{+4}$
71-55-6	1,1,1-Trichloroethane	0.08204	0.05802	1.44×10^{-2}	152	$3.0 \times 10^{+0}$	1.9×10^{-1}	$1.56 \times 10^{+4}$
79-01-6	Trichloroethene	0.08359	0.05912	9.10×10^{-3}	126	$2.5 \times 10^{+0}$	1.5×10^{-1}	$1.77 \times 10^{+4}$
76-13-1	Trichlorotrifluoroethane	0.06721	0.04753	5.26×10^{-1}	372	$7.4 \times 10^{+0}$	$2.9 \times 10^{+0}$	$3.60 \times 10^{+3}$
1330-20-7	Vinyl chloride	0.11048	0.07813	8.19×10^{-2}	57	$1.1 \times 10^{+0}$	$2.9 \times 10^{+0}$	$2.78 \times 10^{+3}$
75-01-4	Xylenes (mixed)	0.07378	0.05218	7.04×10^{-3}	240	$4.8 \times 10^{+0}$	6.0×10^{-2}	$2.99 \times 10^{+4}$

Notes:
D_i = molecular diffusivity.
D_{ei} = effective diffusivity.
H = Henry's law constant.
K_{oc} = organic carbon partition coefficient.
K_d = soil-to-water partition coefficient.
K_{as} = soil-to-air partition coefficient.
VF = volatilization factor.

cm^2/s = square centimeters per second.
$atm \cdot m^3/mol$ = atmosphere·cubic meters per mole.
cm^3/g = cubic centimeters per gram.
g soil/cm^3 air = gram of soil per cubic centimeter of air.
kg/m^3 = kilograms per cubic meter.

and the incidence of adverse health effects in the exposed population. The purpose of this assessment was to identify, for each chemical, a dose-response value that can be used to quantitatively evaluate the potential health risks as a function of exposure. These values will be used, in conjunction with the exposure information presented in Section 3.1, to develop target concentrations.

Separate toxicity assessments were conducted for carcinogenic and noncarcinogenic effects. USEPA has derived cancer slope factors (CSFs) and Reference Doses (RfDs) to evaluate carcinogenic and noncarcinogenic risks, respectively. The definitions of CSFs and RfDs, as stated in USEPA guidance, are as follows.

- The CSF is a plausible upper bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The CSF is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime exposure to a particular concentration of a potential carcinogen (USEPA, 1989a).

- The chronic RfD is an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure concentration for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective from long-term exposure to a compound (as a Superfund program guideline, 7 years to lifetime) (USEPA, 1989a).

Two sources of toxicity and dose-response information were used in this risk assessment: the Integrated Risk Information System (IRIS) and the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1993c; 1993d). IRIS contains descriptive and quantitative toxicity information and is considered to be the most authoritative source of verified USEPA dose-response values. IRIS is the preferred source of toxicity information, including slope factors and reference doses, for supporting risk assessments (USEPA, 1989a). Information contained in IRIS supersedes all other sources of information, and only when information was not available in IRIS was the HEAST consulted. Toxicity information was obtained from the IRIS database in March and April 1992.

The HEAST is prepared quarterly by USEPA's Environmental Criteria and Assessment Office, with input from the Office of Solid Waste's Technical Assessment Branch. This document provides information on chemicals commonly found at both Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and RCRA sites. HEAST summarizes interim and verified slope factors and RfDs, as well as additional toxicity information for specific chemicals.

These toxicity data are combined with exposure information to estimate risk. Carcinogenic risks are determined by multiplying the exposure dose for each carcinogen by its CSF. Multiplication by the CSF converts the estimated daily intake of a chemical, averaged over a lifetime of exposure, into an estimated incremental risk of an individual developing cancer. CSFs used in these calculations are often the upper 95th percentile confidence limits of the slope factors generated from the experimental data. As such, the cancer risk estimates presented in this subsection are upper-bound estimates of risk. The "true risk" of an individual developing cancer as a result of exposure at the estimated dosage is likely to be less than the cancer risk estimate (USEPA, 1989a).

Noncarcinogenic risks are not expressed as a probability of an adverse effect occurring in an individual. Instead, noncarcinogenic risks are estimated by dividing the estimated exposure dose for each noncarcinogen by the appropriate reference dose. The resulting ratio for each chemical is called a Hazard Index (HI).

Based on USEPA guidance (USEPA, 1989a), the target HI for noncarcinogenic compounds is 1.0. If the HI is less than or equal to 1.0, no adverse health effects are anticipated from the predicted exposure dose. If the HI is greater than 1.0, the predicted exposure dose could potentially cause adverse health effects. However, this determination is imprecise, because the derivation of dose-response values (e.g., RfDs) involves the use of multiple uncertainty factors.

The toxicity values for the site contaminants and related chemicals are presented in Table 3-5. This table includes the toxic effects and weight-of-evidence, associated with the available information.

3.3 ESTIMATION OF TARGET CONCENTRATIONS. The target concentrations for Hangar 1000 are based on achieving a residual risk level of 10^{-6} (i.e., 1 in 1 million) for carcinogenic compounds and an HI of 1.0 for noncarcinogenic compounds. These criteria are consistent with the USEPA guidance for RFIs and USEPA risk assessment guidance (USEPA 1989a; 1989d; 1991a; 1991b). The target concentrations also assume likely future land use and exposure scenarios as described in Section 3.1. Some of the contaminants detected at Hangar 1000 are known to be frequently associated with other compounds that were not detected in pervious sampling. Other detected contaminants, such as chlorinated volatile organic compounds, can degrade in soil, generating other compounds of the same class that were not detected at Hangar 1000. To address the possibility of encountering such compounds during remediation, target soil and groundwater concentrations were developed for an expanded list of contaminants, including additional chemicals not actually detected at Hangar 1000. The soil and groundwater target concentrations are presented in the following subsections.

3.3.1 Soil Soil target concentrations derived that meet the appropriate risk criteria, assuming the industrial exposure previously described, were calculated and are presented in Table 3-6. For the site contaminants, these target concentrations range from 66 mg/kg to concentrations greater than 100 percent (1,900,000 mg/kg). The higher soil target concentrations result from the expected low frequency and magnitude of exposure and the low toxicities exhibited by several chemicals (i.e., acetone, toluene, and trichlorotrifluoroethane).

The calculation of target soil and groundwater concentrations for lead is complicated by the lack of toxicity values and the ubiquity of lead in the environment. The USEPA has not developed toxicity values for lead. Most chemicals display a threshold dose below which toxic effects are not observed. Lead, however, has neurotoxic effects at doses so low that no threshold has been identified. Although lead is classified as a class B2 probable human carcinogen, no cancer slope factor has been developed. Therefore, there are no toxicity values available to support calculation of target concentrations.

Another difficulty arises from the ubiquity of lead in the environment. The standard risk assessment methodology assumes that all of a contaminant dose

Table 3-5
Toxicity Values and Chemical-Specific Data
Used in Calculating Target Soil and Groundwater Concentrations

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CAS No.	Chemical Name	WOE Class	Oral CSF 1/(mg/kg·day)	Inhalation CSF 1/(mg/kg·day)	Chronic Oral RfD (mg/kg·day)	Chronic Inhalation RfD (mg/kg·day)	Permeability Constant (cm/hr)	Volatilization Factor (kg/m³)
67-64-1	Acetone	D			$1x10^{-1}$		$1.0x10^{-3}$	$4.43x10^{+4}$
7440-39-3	Barium				$5x10^{-2}$		$8.0x10^{-4}$	
71-43-2	Benzene	A	$2.9x10^{-2}$	$2.9x10^{-2}$			$2.1x10^{-2}$	$1.77x10^{+4}$
117-81-7	bis(2-Ethylhexyl)phthalate	B2	$1.4x10^{-2}$		$2x10^{-2}$		$3.3x10^{-2}$	
7440-43-9	Cadmium	B1			$5x10^{-4}$		$8.0x10^{-4}$	
56-23-5	Carbon tetrachloride	B2	$1.3x10^{-1}$	$5.3x10^{-2}$	$7x10^{-4}$		$2.2x10^{-2}$	$9.98x10^{+3}$
67-66-3	Chloroform	B2	$6.1x10^{-3}$	$8.1x10^{-2}$	$1x10^{-2}$		$8.9x10^{-3}$	$1.49x10^{+4}$
18540-29-9	Chromium (as VI)	A			$5x10^{-3}$		$8.0x10^{-4}$	
106-44-5	Cresol (as para)	C			$5x10^{-3}$		$1.0x10^{-2}$	
75-34-3	1,1-Dichloroethane	C			$1x10^{-1}$	$1x10^{-1}$	$8.9x10^{-3}$	$1.18x10^{+4}$
107-06-2	1,2-Dichloroethane	B2	$9.1x10^{-2}$	$9.1x10^{-2}$			$5.0x10^{-3}$	$1.72x10^{+4}$
75-35-4	1,1-Dichloroethene	C	$6.0x10^{-1}$	$1.2x10^{+0}$	$9x10^{-3}$		$1.6x10^{-2}$	$5.72x10^{+3}$
540-59-0	1,2-Dichloroethene (mixed)	D			$9x10^{-3}$		$1.0x10^{-2}$	$1.12x10^{+4}$
105-67-9	2,4-Dimethylphenol				$2x10^{-2}$		$1.5x10^{-2}$	
84-74-2	Di-N-butyl phthalate				$1x10^{-1}$		$3.3x10^{-2}$	
100-41-4	Ethylbenzene	D			$1x10^{-1}$		$7.4x10^{-2}$	$6.76x10^{+4}$
7439-92-1	Lead	B2					$8.0x10^{-4}$	
78-93-3	Methyl ethyl ketone	D			$6x10^{-1}$		$1.1x10^{-3}$	$6.54x10^{+2}$
75-09-2	Methylene chloride	B2	$7.5x10^{-3}$		$6x10^{-2}$		$4.5x10^{-3}$	$8.58x10^{+3}$
91-20-3	Naphthalene	D			$4x10^{-2}$		$6.9x10^{-2}$	
108-95-2	Phenol	D			$6x10^{-1}$		$5.5x10^{-3}$	
1336-36-3	Polychlorinated biphenyls	B2	$7.7x10^{+0}$				$1.3x10^{+0}$	
127-18-4	Tetrachloroethene	B2	$5.1x10^{-2}$		$1x10^{-2}$		$4.8x10^{-2}$	$1.87x10^{+4}$

See notes at end of table.

Table 3-5 (Continued)
Toxicity Values and Chemical-Specific Data
Used in Calculating Target Soil and Groundwater Concentrations

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

CAS No.	Chemical Name	WOE Class	Oral CSF 1/(mg/kg·day)	Inhalation CSF 1/(mg/kg·day)	Chronic Oral RfD (mg/kg·day)	Chronic Inhalation RfD (mg/kg·day)	Permeability Constant (cm/hr)	Volatilization Factor (kg/m^3)
67-64-1	Acetone	D			$1x10^{-1}$		$1.0x10^{-3}$	$4.43x10^{+4}$
7440-39-3	Barium				$5x10^{-2}$		$8.0x10^{-4}$	
71-43-2	Benzene	A	$2.9x10^{-2}$	$2.9x10^{-2}$			$2.1x10^{-2}$	$1.77x10^{+4}$
117-81-7	bis(2-Ethylhexyl)phthalate	B2	$1.4x10^{-2}$		$2x10^{-2}$		$3.3x10^{-2}$	
7440-43-9	Cadmium	B1			$5x10^{-4}$		$8.0x10^{-4}$	
56-23-5	Carbon tetrachloride	B2	$1.3x10^{-1}$	$5.3x10^{-2}$	$7x10^{-4}$		$2.2x10^{-2}$	$9.98x10^{+3}$
67-66-3	Chloroform	B2	$6.1x10^{-3}$	$8.1x10^{-2}$	$1x10^{-2}$		$8.9x10^{-3}$	$1.49x10^{+4}$
18540-29-9	Chromium (as VI)	A			$5x10^{-3}$		$8.0x10^{-4}$	
106-44-5	Cresol (as para)	C			$5x10^{-3}$		$1.0x10^{-2}$	
75-34-3	1,1-Dichloroethane	C			$1x10^{-1}$	$1x10^{-1}$	$8.9x10^{-3}$	$1.18x10^{+4}$
107-06-2	1,2-Dichloroethane	B2	$9.1x10^{-2}$	$9.1x10^{-2}$			$5.0x10^{-3}$	$1.72x10^{+4}$
75-35-4	1,1-Dichloroethene	C	$6.0x10^{-1}$	$1.2x10^{+0}$	$9x10^{-3}$		$1.6x10^{-2}$	$5.72x10^{+3}$
540-59-0	1,2-Dichloroethene (mixed)	D			$9x10^{-3}$		$1.0x10^{-2}$	$1.12x10^{+4}$
105-67-9	2,4-Dimethylphenol				$2x10^{-2}$		$1.5x10^{-2}$	
84-74-2	Di-N-butyl phthalate				$1x10^{-1}$		$3.3x10^{-2}$	
100-41-4	Ethylbenzene	D			$1x10^{-1}$		$7.4x10^{-2}$	$6.76x10^{+4}$
7439-92-1	Lead	B2					$8.0x10^{-4}$	
78-93-3	Methyl ethyl ketone	D			$6x10^{-1}$		$1.1x10^{-3}$	$6.54x10^{+2}$
75-09-2	Methylene chloride	B2	$7.5x10^{-3}$		$6x10^{-2}$		$4.5x10^{-3}$	$8.58x10^{+3}$
91-20-3	Naphthalene	D			$4x10^{-2}$		$6.9x10^{-2}$	
108-95-2	Phenol	D			$6x10^{-1}$		$5.5x10^{-3}$	
1336-36-3	Polychlorinated biphenyls	B2	$7.7x10^{+0}$				$1.3x10^{+0}$	
127-18-4	Tetrachloroethene	B2	$5.1x10^{-2}$		$1x10^{-2}$		$4.8x10^{-2}$	$1.87x10^{+4}$

See notes at end of table.

Table 3-5 (Continued)
Toxicity Values and Chemical-Specific Data
Used in Calculating Target Soil and Groundwater Concentrations

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

CAS No.	Chemical Name	WOE Class	Oral CSF 1/(mg/kg·day)	Inhalation CSF 1/(mg/kg·day)	Chronic Oral RfD (mg/kg·day)	Chronic Inhalation RfD (mg/kg·day)	Permeability Constant (cm/hr)	Volatilization Factor (kg/m^3)
108-88-3	Toluene	D			$2x10^{-1}$		$4.5x10^{-2}$	$3.27x10^{+4}$
71-55-6	1,1,1-Trichloroethane	D			$9x10^{-2}$	$3x10^{-1}$	$1.7x10^{-2}$	$1.56x10^{+4}$
79-01-6	Trichloroethene	B2	$1.1x10^{-2}$				$1.6x10^{-2}$	$1.77x10^{+4}$
76-13-1	Trichlorotrifluoroethane				$3x10^{+1}$		$8.0x10^{-4}$	$3.60x10^{+3}$
75-01-4	Vinyl chloride	A	$1.9x10^{+0}$	$3.0x10^{-1}$			$7.5x10^{-3}$	$2.78x10^{+3}$
1330-20-7	Xylenes (mixed)	D			$2x10^{+0}$		$8.0x10^{-2}$	$2.99x10^{+4}$

Notes: WOE = Weight of evidence classification with respect to carcinogenicity.

A = known human carcinogen.
B1 = probable human carcinogen, limited human data.
B2 = probable human carcinogen, inadequate or no human data.
C = possible human carcinogen.
D = not classifiable as human carcinogen.

CSF = cancer slope factor.
RfD = Reference Dose.
1/(mg/kg·day) = per (milligrams per kilogram of body weight per day).
mg/kg·day = milligrams per kilogram of body weight per day.
cm/hr = centimeters per hour.
kg/m^3 = kilograms per cubic meter.

Toxicity values obtained on November 23, 1993 from database updated October 6, 1993 and database updated July 19, 1993.

Table 3-6
Target Soil Concentrations, Worker-Industrial Land Use

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

CAS No.	Chemical Name	Maximum Detected Soil Concentration (mg/kg)	Final Target Soil Concentration (mg/kg)	Target Soil Concentration Based on $1x10^{-6}$ Cancer Risk (mg/kg)	Target Soil Concentration Based on Hazard Index = 1 (mg/kg)
67-64-1	Acetone	5.2	5,900		5,900
7440-39-3	Barium	22.2	3,000		3,000
71-43-2	Benzene	ND	1,600	1,600	
117-81-7	bis(2-Ethylhexyl)phthalate	0.955	1,200	3,600	1,200
7440-43-9	Cadmium	25.3	30		30
56-23-5	Carbon tetrachloride	0.018	42	360	42
67-66-3	Chloroform	ND	600	2,900	600
18540-29-9	Chromium	14.1	300 (as VI)		300 (as VI)
106-44-5	Cresol (as para)	ND	300		300
75-34-3	1,1-Dichloroethane	1.85	5,900		5,900
107-06-2	1,2-Dichloroethane	ND	490	490	
75-35-4	1,1-Dichloroethene	1.883	48	48	530
540-59-0	1,2-Dichloroethene (mixed)	ND	530		530
105-67-9	2,4-Dimethylphenol	ND	1,200		1,200
84-74-2	Di-N-butyl phthalate	ND	5,900		5,900
100-41-4	Ethylbenzene	2.0	5,900		5,900
7439-92-1	Lead	27.0	[1]500		
78-93-3	Methyl ethyl ketone	ND	36,000		36,000
75-09-2	Methylene chloride	2.0	3,600	6,700	3,600
91-20-3	Naphthalene	1.04	2,400		2,400
108-95-2	Phenol	ND	36,000		36,000
1336-36-3	Polychlorinated biphenyls	ND	6.6	6.6	
127-18-4	Tetrachloroethene	31.45	600	990	600
108-88-3	Toluene	11.35	12,000		12,000
71-55-6	1,1,1-Trichloroethane	52.0	5,300		5,300
79-01-6	Trichloroethene	6.3	4,600	4,600	
76-13-1	Trichlorotrifluoroethane	0.783	1,800,000		1,800,000
75-01-4	Vinyl chloride	ND	24	24	
1330-20-7	Xylenes (mixed)	14.75	120,000		120,000

[1] Lower lead cleanup level recommended in Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.4-02 (USEPA, 1989e).

Notes: $1x10^{-6}$ = one in a million.
mg/kg = milligrams of chemical per kilogram of soil.
ND = not detected in any of the samples taken at Hangar 1000.

originates from the contaminated site. Calculating the contaminant dose received from the site allows estimation of the total risks due to that contaminant. Because the human receptors will take in lead from other sources, such as air pollution and public water supplies, the extra dosage of lead from site contamination might increase the total dosage to an unacceptable level. A reduction in target lead concentrations may be justified to limit the risks incurred by any individual receptor.

The USEPA has developed a recommendation for target soil levels for lead cleanups under CERCLA. This recommendation is for levels of 500 to 1,000 mg/kg lead in soils (USEPA, 1989e). The lower level recommended has been adopted as the target soil concentration for this HEA.

None of the soil contaminants at Hangar 1000 were detected in excess of their respective target concentrations. Therefore, remedial actions are not necessary to protect future workers from exposure to soils at this site.

3.3.2 Groundwater Groundwater target concentrations derived to achieve the appropriate risk criteria were calculated and are presented in Table 3-7. These concentrations range from 0.00011 milligrams per liter (mg/ℓ) to 14,000,000 mg/ℓ. The relatively high concentrations derived for this route of exposure are a result of the low magnitude and frequency of possible exposure, and because the skin provides an effective barrier against contaminant transport, especially at low concentrations. In addition, some contaminants (i.e., acetone and 1,1,1-trichloroethane) exhibit relatively low toxicity.

A target groundwater concentration for lead has been calculated on the basis of an acceptable daily intake derived from the lead MCL action level.

$$ADI = \frac{0.015\ mg/\ell \times 2\ \ell/day}{70\ kg} = 4.29 \times 10^{-4}\ mg/kg \cdot day \qquad (7)$$

where

ADI	=	acceptable daily intake in milligrams of lead per kilogram of body weight per day,
0.015	=	MCL action level for lead in milligrams per liter (mg/ℓ),
2	=	liters of water consumed per day (ℓ/day), and
70	=	adult body weight in kilograms (kg).

In the nonpotable use scenario, workers are exposed to groundwater via dermal contact, as in handwashing. Because these workers may be exposed to lead from other sources, the target groundwater concentration for lead is calculated on the basis of one hundredth of the ADI.

$$C_{water} = \frac{0.01 \times ADI \times BW \times AT}{SA \times PC \times CF \times EF \times ED \times ET} = 2{,}000\ \mu g/\ell \qquad (8)$$

where

C_{water}	=	target groundwater concentration, micrograms of lead per liter of groundwater,
ADI	=	acceptable daily intake, 4.29×10^{-4} milligrams of lead per kilogram of body weight per day,
BW	=	bodyweight of 70 kilograms,

Table 3-7
Target Groundwater Concentrations, Nonpotable Use

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

CAS No.	Chemical Name	Maximum Detected Groundwater Concentration (mg/ℓ)	Final Target Groundwater Concentration (mg/ℓ)	Target Groundwater Concentration Based on $1x10^{-6}$ Cancer Risk (mg/ℓ)	Target Groundwater Concentration Based on Hazard Index = 1 (mg/ℓ)
67-64-1	Acetone	0.015	38,000		38,000
7440-39-3	Barium	0.199	24,000		24,000
71-43-2	Benzene	ND	1.7	1.7	
117-81-7	bis(2-Ethylhexyl)phthalate	0.005	2.3	2.3	230
7440-43-9	Cadmium	ND	240		240
56-23-5	Carbon tetrachloride	ND	0.37	0.37	12
67-66-3	Chloroform	0.014	19	19	420
18540-29-9	Chromium	0.0263	2,400 (as VI)		2,400 (as VI)
106-44-5	Cresol (as para)	ND	190		190
75-34-3	1,1-Dichloroethane	0.073	4,200		4,200
107-06-2	1,2-Dichloroethane	ND	2.3	2.3	
75-35-4	1,1-Dichloroethene	0.066	0.11	0.11	210
540-59-0	1,2-Dichloroethene (mixed)	0.059	340		340
105-67-9	2,4-Dimethylphenol	ND	500		500
84-74-2	Di-N-butyl phthalate	0.001	1,100		1,100
100-41-4	Ethylbenzene	ND	510		510
7439-92-1	Lead	0.0156	2.0		
78-93-3	Methyl ethyl ketone	ND	210,000		210,000
75-09-2	Methylene chloride	0.006	31	31	5,000
91-20-3	Naphthalene	ND	220		220
108-95-2	Phenol	ND	41,000		41,000
1336-36-3	Polychlorinated biphenyls	ND	0.00011	0.00011	
127-18-4	Tetrachloroethene	0.007	0.43	0.43	79
108-88-3	Toluene	ND	1,700		1,700
71-55-6	1,1,1-Trichloroethane	0.44	2,000		2,000
79-01-6	Trichloroethene	0.37	6.0	6.0	
76-13-1	Trichlorotrifluoroethane	ND	14,000,000		14,000,000
75-01-4	Vinyl chloride	ND	0.07	0.07	
1330-20-7	Xylenes (mixed)	ND	9,400		9,400

Notes: $1x10^{-6}$ = one in a million.
mg/ℓ = milligrams of chemical per liter of groundwater.
ND = not detected in samples taken at Hangar 1000.

AT	=	averaging time, 365 days per years times 25 years,
SA	=	exposed skin surface area of 820 square centimeters,
PC	=	permeability coefficient for water used as default value, 0.0008 centimeters per hour,
CF	=	conversion factor used to correct units, 0.000001 milligram • liters per microgram • cubic centimeters,
EF	=	exposure frequency of 250 days per year,
ED	=	exposure duration of 25 years, and
ET	=	exposure time of 0.33 hours per handwashing event.

The target soil and groundwater concentrations for lead of 500 mg/kg and 2,000 $\mu g/\ell$, respectively, are both designed to be adequately protective provided that the receptor is exposed to no other major source of lead.

None of the groundwater contaminants were observed in excess of their respective target concentrations. Therefore, remedial actions are not necessary to protect future workers from dermal exposure to groundwater. In addition, no soil target concentrations must be developed to prevent any chemicals from exceeding their target concentrations in groundwater.

3.4 UNCERTAINTIES AND LIMITATIONS. Quantitative estimates of exposure and risk-based target concentrations are based on numerous assumptions that are intended to be protective of human health. The estimates used in this HEA are subject to various sources of uncertainty, resulting from multiple layers of conservative assumptions. Sources of uncertainty can be categorized into site-specific factors and toxicity assessment factors and include:

- likelihood of exposure pathway,
- exposure assumptions (i.e., frequency and duration of exposure),
- extrapolation of animal toxicity data to human exposure,
- use of linearized multistage model to derive cancer slope factors, and
- use of uncertainty factors in the derivation of RfDs.

Most assumptions incorporated into the estimation procedures employed in this HEA are inherently conservative. The first two are related to site-specific information at Hangar 1000. As stated in Section 3.2, it is unlikely that exposure to subsurface soils and/or groundwater will occur. Further, the assumed frequency and duration of exposure are considered to overestimate actual exposure. The remaining items are uncertainties related to standard USEPA guidance. Collectively, these factors provide an upper-bound estimate of potential exposure and risk. Therefore, the proposed target concentrations are expected to provide an adequate level of protection for future potential human receptors.

4.0 SUMMARY AND RECOMMENDATIONS

As reported in the SAR, halogenated and non-halogenated organic chemicals and metals are present in the subsurface soil and groundwater of the Hangar 1000 keyway. This HEA describes the methodology and rationale for developing target concentrations for site-related contaminants at Hangar 1000. These target concentrations provide adequate protection of both human health and the environment and are used to determine the need for and effectiveness of various remedial actions.

Target concentrations have also been developed for a number of chemicals not detected at Hangar 1000. Some groups of compounds are known to frequently occur together as contaminants. Some compounds, such as chlorinated volatile organic compounds, may degrade in the environment to generate simpler compounds of the same class. To allow for the possibility of encountering these additional contaminants during remediation, target concentrations for soil and groundwater have been calculated.

The land use at Hanger 1000 is industrial, as this site is part of the flightline support services at NAS Jacksonville. The hangar is currently operational and likely to remain so in the foreseeable future. The site is entirely covered by asphalt and concrete with no current or regularly scheduled subsurface maintenance activities. All site-related soil contamination is confined to subsurface soils. These are effectively capped by the concrete and asphalt surfaces. This area of NAS Jacksonville is serviced by the NAS Jacksonville water system, which draws water from the Floridan aquifer system. The surficial groundwater beneath the site in not used for domestic, industrial, or potable purposes and is unlikely to be used for such purposes in the future.

Based on the current and likely future land use at this site, two exposure scenarios were developed to estimate potential contaminant exposure: (1) concurrent exposure through dermal contact and incidental ingestion of subsurface soils and inhalation of soil particulates and (2) dermal contact with groundwater. Appropriate toxicity information was obtained for the site-related contaminants and combined with these two potential exposure scenarios to derive target concentrations.

The target concentrations for groundwater contaminants ranged from 0.00011 to 14,000,000 mg/ℓ and for soil contaminants ranged from approximately 251 mg/kg to greater than 10 percent concentration (i.e., greater than 100,000 mg/kg). These relatively high concentrations are a function of the limited possible exposure at the site and relatively low toxicity exhibited by some of the site related contaminants. The soil target concentrations are similar to the soil criteria developed by USEPA Region III. No contaminant was detected in excess of its respective target concentration.

The comparison of maximum detected concentrations to the target concentrations support the conclusion that no remedial actions are necessary to provide additional protection to human health. This result is not unexpected given the limited exposure to subsurface soil or groundwater contaminants at the site. Because the land use at Hangar 1000 is expected to remain industrial, the scenarios used in this HEA are also reflective of future potential exposures.

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APPENDIX A

SOIL AND GROUNDWATER COMPARISON TABLES

Table A-1
Comparison of Hangar 1000 Soil Metal Concentrations
With Thermal Treatment Soil Criteria for Metals

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

Chemical	Maximum Concentration Detected (mg/kg)	FAC 17-775.400[1] Maximum Concentration (mg/kg)
Barium	55.8	4,940
Cadmium	25.3	37
Chromium	9.13	50
Lead	9.55	108
Total volatile halogenated organic chemicals	([2])	0.050

[1] Florida Department of Environmental Regulation (FDER) Criteria for Clean Soil, based on thermal treatment of petroleum wastes, Chapter 17-775.400, Florida Administrative Code (FAC), November 30, 1992.
[2] See Table 2-1.

Note: mg/kg = milligrams per kilogram.

Table A-2
Comparison of Hangar 1000 Soil Metal Concentrations With Region III Screening Criteria

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

Contaminants	Maximum Concentration Detected (mg/kg)	Region III Worker Soil Ingestion (mg/kg)
Acetone	5.2	100,000
bis(2-Ethylhexyl)phthalate	9.86	200
Carbon tetrachloride	0.018	22
1,1-Dichloroethane	1.85	100,000
1,1-Dichloroethene	1.88	4.8
Ethylbenzene	2.00	100,000
Methylene chloride	2.00	380
Naphthalene	1.04	NA
Tetrachloroethene	31.45	55
Toluene	11.35	200,000
1,1,1-Trichloroethane	52.0	92,000
Trichloroethene	6.30	260
Trichlorotrifluoroethane	0.783	NA
Xylenes (mixed)	14.75	1,000,000
Barium	55.8	72,000
Cadmium	25.3	510
Chromium	9.13	5,100 (as VI)
Lead	9.55	NA

Notes: mg/kg = milligrams per kilogram.
NA = data not available.

Table A-3
Comparison of Hangar 1000 Water Contaminant Concentrations With Drinking Water Standards

Health and Environmental Assessment
Hangar 1000
NAS Jacksonville, Florida

Chemicals	Maximum Detected Concentration ($\mu g/\ell$)	Federal		Florida MCL ($\mu g/\ell$)
		MCL ($\mu g/\ell$)	MCLG ($\mu g/\ell$)	
Acetone	15	NA	NA	NA
Barium	199	2,000	2,000	1,000
Di-n-butylphthalate	1	NA	NA	NA
Chloroform	14	100	0	[1]100
Chromium (total)	26.3	100	100	50
1,1-Dichloroethane	51	NA	NA	NA
1,1-Dichloroethene	43	7	7	7
cis-1,2-Dichloroethene	[2]43	70	70	NA
trans-1,2-Dichloroethene	[2]43	100	100	NA
Lead	8.1	15	0	50
Tetrachloroethene	7	5	0	3
1,1,1-Trichloroethane	330	200	200	200
Trichloroethene	320	5	0	3

[1] Total trihalomethanes.
[2] Value detected is total 1,2-dichloroethene.

Notes: MCL = maximum contaminant level, U.S. Environmental Protection Agency (USEPA) Office of Water 1991, USEPA 570/9-91-012FS.
MCLG = maximum contaminant level goal, USEPA Office of Water 1991, not a promulgated standard.
$\mu g/\ell$ = micrograms per liter.
Florida MCL = Primary Drinking Water Standards, Maximum Contaminant Levels, Florida Department of Environmental Regulation (FDER) 1991, Chapter 17-550.310, Florida Adminstrative Code.
NA = not available.

APPENDIX B

RISK-BASED CONCENTRATION TABLE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107

October 15, 1993

SUBJECT: Risk-Based Concentration Table, Fourth Quarter 1993

FROM: Roy L. Smith, Ph.D., Senior Toxicologist
Technical Support Section (3HW13)

TO: RBC Table mailing list

Attached is the EPA Region III risk-based concentration table, which we have distributed quarterly to all interested parties since 1991. If you are not currently on the mailing list, but would like to be, please contact Anna Poulton (phone: 215-597-3179, fax: 215-597-9890) and give her your name, address, and phone and fax numbers.

IMPORTANT MESSAGE: It's once again time to re-register for the RBC table mailing list. We need to hear from you periodically to ensure that you still have an interest in the table, and that we have your correct address. If you have been on the mailing list since before October 1992, and would like to continue receiving the RBC table, please fax your request to re-register (or register for the first time) to Anna Poulton, along with any needed address or phone number changes. You need not respond if you were placed on the mailing list after October 1992, or if you are a Region III staff member. Please don't phone to re-register; we prefer tangible documentation, to help justify continued funding. Thanks for your cooperation.

The table contains reference doses and carcinogenic potency slopes (obtained from IRIS through October 1, 1993, HEAST through July 1993, OHEA-Cincinnati, and other EPA sources) for nearly 600 chemicals. These toxicity constants have been combined with "standard" exposure scenarios to calculate chemical concentrations corresponding to fixed levels of risk (*i.e.*, a hazard quotient of 1, or lifetime cancer risk of 10^{-6}, whichever occurs at a lower concentration) in water, air, fish tissue, and soil.

The Region III toxicologists use this table as a risk-based screen for Superfund sites, and as a desk reference for emergencies and requests for immediate information. The table also provides a useful benchmark for evaluating site investigation data and preliminary remediation goals. The table has no official status as either regulation or guidance, and should be used only as a predictor of generic single-contaminant health risk estimates. *The table is specifically not intended as (1) a stand-alone decision-making tool, (2) a substitute for EPA guidance for preparing baseline risk assessments, (3) a source of site-specific cleanup levels, or (4) a rule to determine if a waste is hazardous under RCRA.* In general, chemical concentrations above the levels in the table suggest a need for a closer look by a toxicologist, but should not be used as the sole basis for taking any action.

The toxicity information in the table has been assembled by hand, and (despite extensive checking and several years' use) may contain errors. It's advisable to cross-check before relying on any numbers in the table. If you find any errors, please send me a note.

This update of the table includes major changes in algorithms and toxicity constants, which render all prior versions of the table obsolete. The new algorithms concern lifetime exposure to carcinogens. The lifetime algorithms in the last version of this table were conceptually incorrect, due to my error. I thank Region III Toxicologist Jennifer Hubbard for alerting me to this problem. The corrected formulae are described in the attached Background Information. This change caused risk-based concentrations for carcinogens to decrease (*i.e.,* become more protective) by approximately 20% for air and tap water, and nearly 50% for residential soil. It did not affect risk-based concentrations for non-carcinogens, or for any contaminant in fish tissue and commercial/industrial soil.

This update contains revised reference doses or carcinogenic potency slopes (and therefore new risk-based concentrations) for the following substances:

Acetochlor
Atrazine
Benzene
1,2-Bromoethane
2-Chloro-1,3-butadiene
Chrysene
Cyanazine
1,2-Dibromo-3-chloropropane
2,6-Dinitrotoluene
Endosulfan
Hexachlorobutadiene
2-Methoxyethanol
Methyl tertbutyl ether (MTBE)
2-Nitroaniline
o-Nitrotoluene
o-Phenylenediamine
Simazine
2-(Thiocyanomethylthio)-benzothiazole (TCMTB)
p-Toluidine
m-Xylene
o-Xylene

Attachment

Risk-Based Concentration Table
Background Information

General: Separate carcinogenic and non-carcinogenic risk-based concentrations were calculated for each compound for each pathway. The concentration in the table is the lower of the two, rounded to two significant figures. The following terms and values were used in the calculations:

Exposure variables	Value	Name
1-General:		
Carcinogenic potency slope oral (kg-d/mg):	*	CPSo
Carcinogenic potency slope inhaled (kg-d/mg):	*	CPSi
Reference dose oral (mg/kg/d):	*	RfDo
Reference dose inhaled (mg/kg/d):	*	RfDi
Target cancer risk:	1e-06	TR
Target hazard quotient:	1	THQ
Body weight, adult (kg):	70	BWa
Body weight, age 1-6 (kg):	15	BWc
Averaging time carcinogens (d):	25550	ATc
Averaging time non-carcinogens (d):	ED*365	ATn
Inhalation, adult (m3/d):	20	IRAa
Inhalation, child (m3/d):	12	IRAc
Inhalation factor, age-adjusted (m3-y/kg-d):	11.66	IFAadj
Tap water ingestion, adult (L/d):	2	IRWa
Tap water ingestion, age 1-6 (L/d):	1	IRWc
Tap water ingestion factor, age-adjusted (L-y/kg-d):	1.09	IFWadj
Fish ingestion (g/d):	54	IRF
Soil ingestion, adult (mg/d):	100	IRSa
Soil ingestion, age 1-6 (mg/d):	200	IRSc
Soil ingestion factor, age adjusted (mg-y/kg-d):	114.29	IFSadj
2-Residential:		
Exposure frequency (d/y):	350	EFr
Exposure duration, total (y):	30	EDtot

Exposure variables	Value	Name
Exposure duration, age 1-6 (y):	6	EDc
Volatilization factor (L/m3):	0.5	VF
3-Occupational:		
Exposure frequency (d/y):	250	EFo
Exposure duration (y):	25	EDo
* = Contaminant-specific toxicity parameters		

The priority among sources of toxicological constants was as follows: (1) IRIS, (2) HEAST, (3) HEAST alternative method, (4) ECAO-Cincinnati, (5) withdrawn from IRIS, (6) withdrawn from HEAST, and (7) other EPA documents. Each source was used only if numbers from higher-priority sources were unavailable.

Algorithms:

1. Age-adjusted factors: Because contact rates with tap water, ambient air, and residential soil are different for children and adults, carcinogenic risks during the first 30 years of life were calculated using age-adjusted factors. These factors approximated the integrated exposure from birth until age 30 by combining contact rates, body weights, and exposure durations for two age groups - small children and adults. The age-adjusted factor for soil was obtained from RAGS IB; the others were developed by analogy.

a. Air inhalation ([m^3· y]/[kg· d]):

$$IFAadj = \frac{EDc \cdot IRAc}{BWc} + \frac{(EDtot - EDc) \cdot IRAa}{BWa}$$

b. Tap water ingestion ([L· y]/[kg· d]):

$$IFWadj = \frac{EDc \cdot IRWc}{BWc} + \frac{(EDtot - EDc) \cdot IRWa}{BWa}$$

c. Soil ingestion ([mg· y]/[kg· d]):

$$IFSadj = \frac{EDc \cdot IRSc}{BWc} + \frac{(EDtot - EDc) \cdot IRSa}{BWa}$$

2. Residential water use (μg/L). Volatilization terms were calculated only for compounds with "y" in the "VOC" column. Compounds having a Henry's Law constant greater than 10^{-5} were considered volatile. The list may be incomplete, but is unlikely to include false positives. The equations and the volatilization factor (VF, above) were obtained from RAGS IB. Oral potency slopes and reference doses were used for both oral and inhaled exposures for volatile compounds lacking inhalation values. Inhaled potency slopes were substituted for unavailable oral potency slopes only for volatile compounds; inhaled RfDs were substituted for unavailable oral RfDs for both volatile and non-volatile compounds.

a. Carcinogens: Calculations were based on combined childhood and adult exposure.

$$\frac{TR \cdot ATc \cdot 1000\frac{ug}{mg}}{EFr \cdot ([VF \cdot IFAadj \cdot CPSi] + [IFWadj \cdot CPSo])}$$

b. Non-carcinogens: Calculations were based on adult exposure.

$$\frac{THQ \cdot BWa \cdot ATn \cdot 1000\frac{ug}{mg}}{EFr \cdot EDall \cdot \left(\frac{VF \cdot IRAa}{RfDi} + \frac{IRWa}{RfDo}\right)}$$

3. Air (μg/m^3). Oral potency slopes and references were used where inhalation values were not available.

a. Carcinogens: Calculations were based on combined childhood and adult exposure.

$$\frac{TR \cdot ATc \cdot 1000\frac{ug}{mg}}{EFr \cdot IFAadj \cdot CPSi}$$

b. Non-carcinogens: Calculations were based on adult exposure.

$$\frac{THQ \cdot RfDi \cdot BWa \cdot ATn \cdot 1000\frac{ug}{mg}}{EFr \cdot EDall \cdot IRAa}$$

4. Fish (mg/kg):

a. Carcinogens: Calculations were based on adult exposure.

$$\frac{TR \cdot BWa \cdot ATc}{EFr \cdot EDall \cdot \frac{IRF}{1000\frac{g}{kg}} \cdot CPSo}$$

b. Non-carcinogens: Calculations were based on adult exposure.

$$\frac{THQ \cdot RfDo \cdot BWa \cdot ATn}{EFr \cdot EDall \cdot \frac{IRF}{1000\frac{g}{kg}}}$$

5. Soil commercial/industrial (mg/kg): The default exposure assumption that only 50% of incidental soil ingestion occurs at work has been omitted. Calculations were based on adult occupational exposure.

a. Carcinogens:

$$\frac{TR \cdot BWa \cdot ATc}{EFo \cdot EDo \cdot \frac{IRSa}{10^6\ \frac{mg}{kg}} \cdot CPSo}$$

b. Non-carcinogens:

$$\frac{THQ \cdot RfDo \cdot BWa \cdot ATn}{EFo \cdot EDo \cdot \frac{IRSa}{10^6\ \frac{mg}{kg}}}$$

6. Soil residential (mg/kg):

a. Carcinogens: Calculations were based on combined childhood and adult exposure.

$$\frac{TR \cdot ATc}{EFr \cdot \frac{IFSadj}{10^6\ \frac{mg}{kg}} \cdot CPSo}$$

b. Non-carcinogens: Calculations were based on childhood exposure only.

$$\frac{THQ \cdot RfDo \cdot BWc \cdot ATn}{EFr \cdot EDc \cdot \frac{IRSc}{10^6\ \frac{mg}{kg}}}$$

Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
Acephate	4.00e-03 *i*		8.70e-03 *i*			7.7	0.72	0.36	330	73
Acetaldehyde		2.57e-03 *i*		7.70e-03 *i*		94	0.81			
Acetochlor	2.00e-02 *i*					730	73	27	20000	1600
Acetone	1.00e-01 *i*					3700	370	140	100000	7800
Acetone cyanohydrin	7.00e-02 *h*	2.86e-03 *a*				2600	10	95	72000	5500
Acetonitrile	6.00e-03 *i*	1.43e-02 *a*				220	52	8.1	6100	470
Acetophenone	1.00e-01 *i*	5.71e-06 *y*			y	0.042	0.021	140	100000	7800
Acifluorfen	1.30e-02 *i*					470	47	18	13000	1000
Acrolein	2.00e-02 *h*	5.71e-06 *i*				730	0.021	27	20000	1600
Acrylamide	2.00e-04 *i*		4.50e+00 *i*	4.55e+00 *i*		0.015	0.0014	0.0007	0.64	0.14
Acrylic acid	8.00e-02 *i*	8.57e-05 *i*				2900	0.31	110	82000	6300
Acrylonitrile		5.71e-04 *i*	5.40e-01 *i*	2.38e-01 *i*		0.12	0.026	0.0058	5.3	1.2
Alachlor	1.00e-02 *i*		8.00e-02 *h*			0.84	0.078	0.039	36	8
Alar	1.50e-01 *i*					5500	550	200	150000	12000
Aldicarb	2.00e-04 *i*					7.3	0.73	0.27	200	16
Aldicarb sulfone	3.00e-04 *x*					11	1.1	0.41	310	23
Aldrin	3.00e-05 *i*		1.70e+01 *i*	1.72e+01 *i*		0.004	0.00037	0.00019	0.17	0.038
Ally	2.50e-01 *i*					9100	910	340	260000	20000
Allyl alcohol	5.00e-03 *i*					180	18	6.8	5100	390
Allyl chloride	5.00e-02 *y*	2.86e-04 *i*				1800	1	68	51000	3900
Aluminum	2.90e+00 *o*					110000	11000	3900	1000000	230000
Aluminum phosphide	4.00e-04 *i*					15	1.5	0.54	410	31
Amdro	3.00e-04 *i*					11	1.1	0.41	310	23
Ametryn	9.00e-03 *i*					330	33	12	9200	700
m-Aminophenol	7.00e-02 *h*					2600	260	95	72000	5500
4-Aminopyridine	2.00e-05 *h*					0.73	0.073	0.027	20	1.6
Amitraz	2.50e-03 *i*					91	9.1	3.4	2600	200
Ammonia		2.86e-02 *i*				1000	100			
Ammonium sulfamate	2.00e-01 *i*					7300	730	270	200000	16000
Aniline		2.86e-04 *i*	5.70e-03 *i*			10	1	0.55	500	110
Antimony and compounds	4.00e-04 *i*					15	1.5	0.54	410	31
Antimony pentoxide	5.00e-04 *h*					18	1.8	0.68	510	39
Antimony potassium tartrate	9.00e-04 *h*					33	3.3	1.2	920	70
Antimony tetroxide	4.00e-04 *h*					15	1.5	0.54	410	31
Antimony trioxide	4.00e-04 *h*					15	1.5	0.54	410	31
Apollo	1.30e-02 *i*					470	47	18	13000	1000
Aramite	5.00e-02 *h*		2.50e-02 *i*	2.49e-02 *i*		2.7	0.25	0.13	110	26
Arsenic	3.00e-04 *i*					11	1.1	0.41	310	23

Key to Data Sources: i=IRIS h=HEAST a=HEAST alternate method x=Withdrawn from IRIS y=Withdrawn from HEAST e=EPA-ECAO o=Other EPA documents.

Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
Arsenic (as carcinogen)			1.75e+00 *i*	1.51e+01 *i*		0.038	0.00042	0.0018	1.6	0.36
Assure	9.00e-03 *i*					330	33	12	9200	700
Asulam	5.00e-02 *i*					1800	180	68	51000	3900
Atrazine	3.50e-02 *i*		2.22e-01 *h*			0.3	0.028	0.014	13	2.9
Avermectin B1	4.00e-04 *i*					15	1.5	0.54	410	31
Azobenzene			1.10e-01 *i*	1.09e-01 *i*		0.61	0.058	0.029	26	5.8
Barium and compounds	7.00e-02 *i*	1.43e-04 *a*				2600	0.52	95	72000	5500
Baygon	4.00e-03 *i*					150	15	5.4	4100	310
Bayleton	3.00e-02 *i*					1100	110	41	31000	2300
Baythroid	2.50e-02 *i*					910	91	34	26000	2000
Benefin	3.00e-01 *i*					11000	1100	410	310000	23000
Benomyl	5.00e-02 *i*					1800	180	68	51000	3900
Bentazon	2.50e-03 *i*					91	9.1	3.4	2600	200
Benzaldehyde	1.00e-01 *i*				y	610	370	140	100000	7800
Benzene		1.43e-04 *e*	2.90e-02 *i*	2.91e-02 *i*	y	0.36	0.22	0.11	99	22
Benzidine	3.00e-03 *i*		2.30e+02 *i*	2.35e+02 *i*		0.00029	0.000027	0.000014	0.012	0.0028
Benzoic acid	4.00e+00 *i*					150000	15000	5400	1000000	310000
Benzotrichloride			1.30e+01 *i*			0.0052	0.00048	0.00024	0.22	0.049
Benzyl alcohol	3.00e-01 *h*					11000	1100	410	310000	23000
Benzyl chloride			1.70e-01 *i*		y	0.062	0.037	0.019	17	3.8
Beryllium and compounds	5.00e-03 *i*		4.30e+00 *i*	8.40e+00 *i*		0.016	0.00075	0.00073	0.67	0.15
Bidrin	1.00e-04 *i*					3.7	0.37	0.14	100	7.8
Biphenthrin (Talstar)	1.50e-02 *i*					550	55	20	15000	1200
1,1-Biphenyl	5.00e-02 *i*					1800	180	68	51000	3900
Bis(2-chloroethyl)ether			1.10e+00 *i*	1.16e+00 *i*	y	0.0092	0.0054	0.0029	2.6	0.58
Bis(2-chloroisopropyl)ether	4.00e-02 *i*		7.00e-02 *h*	3.50e-02 *h*	y	0.26	0.18	0.045	41	9.1
Bis(chloromethyl)ether			2.20e+02 *i*	2.17e+02 *i*	y	0.000049	0.000029	0.000014	0.013	0.0029
Bis(2-chloro-1-methylethyl)ether			7.00e-02 *y*	7.00e-02 *y*		0.96	0.089	0.045	41	9.1
Bis(2-ethylhexyl)phthalate (DEHP)	2.00e-02 *i*		1.40e-02 *i*			4.8	0.45	0.23	200	46
Bisphenol A	5.00e-02 *i*					1800	180	68	51000	3900
Boron (and borates)	9.00e-02 *i*	5.71e-03 *h*				3300	21	120	92000	7000
Boron trifluoride		2.00e-04 *h*				7.3	0.73			
Bromodichloromethane	2.00e-02 *i*		6.20e-02 *i*		y	0.17	0.1	0.051	46	10
Bromoethene				1.10e-01 *h*	y	0.096	0.057			
Bromoform (tribromomethane)	2.00e-02 *i*		7.90e-03 *i*	3.85e-03 *i*	y	2.4	1.6	0.4	360	81
Bromomethane	1.40e-03 *i*	1.43e-03 *i*			y	8.7	5.2	1.9	1400	110
4-Bromophenyl phenyl ether	5.80e-02 *o*					2100	210	78	59000	4500
Bromophos	5.00e-03 *h*					180	18	6.8	5100	390

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
Bromoxynil	2.00e-02 *i*					730	73	27	20000	1600
Bromoxynil octanoate	2.00e-02 *i*					730	73	27	20000	1600
1,3-Butadiene				9.80e-01 *i*	y	0.011	0.0064			
1-Butanol	1.00e-01 *i*					3700	370	140	100000	7800
Butylate	5.00e-02 *i*					1800	180	68	51000	3900
Butyl benzyl phthalate	2.00e-01 *i*					7300	730	270	200000	16000
Butylphthalyl butylglycolate	1.00e+00 *i*					37000	3700	1400	1000000	78000
Cacodylic acid	3.00e-03 *h*					110	11	4.1	3100	230
Cadmium and compounds	5.00e-04 *i*			6.30e+00 *i*		18	0.00099	0.68	510	39
Caprolactam	5.00e-01 *i*					18000	1800	680	510000	39000
Captafol	2.00e-03 *i*		8.60e-03 *h*			7.8	0.73	0.37	330	74
Captan	1.30e-01 *i*		3.50e-03 *h*			19	1.8	0.9	820	180
Carbaryl	1.00e-01 *i*					3700	370	140	100000	7800
Carbazole			2.00e-02 *h*			3.4	0.31	0.16	140	32
Carbofuran	5.00e-03 *i*					180	18	6.8	5100	390
Carbon disulfide	1.00e-01 *i*	2.86e-03 *h*			y	21	10	140	100000	7800
Carbon tetrachloride	7.00e-04 *i*	5.71e-04 *e*	1.30e-01 *i*	5.25e-02 *i*	y	0.16	0.12	0.024	22	4.9
Carbosulfan	1.00e-02 *i*					370	37	14	10000	780
Carboxin	1.00e-01 *i*					3700	370	140	100000	7800
Chloral	2.00e-03 *i*					73	7.3	2.7	2000	160
Chloramben	1.50e-02 *i*					550	55	20	15000	1200
Chloranil			4.03e-01 *h*			0.17	0.016	0.0078	7.1	1.6
Chlordane	6.00e-05 *i*		1.30e+00 *i*	1.30e+00 *i*		0.052	0.0048	0.0024	2.2	0.49
Chlorimuron-ethyl	2.00e-02 *i*					730	73	27	20000	1600
Chlorine dioxide		5.71e-05 *i*				2.1	0.21			
Chloroacetaldehyde	6.90e-03 *o*					250	25	9.3	7100	540
Chloroacetic acid	2.00e-03 *h*					73	7.3	2.7	2000	160
2-Chloroacetophenone		8.57e-06 *i*				0.31	0.031			
4-Chloroaniline	4.00e-03 *i*					150	15	5.4	4100	310
Chlorobenzene	2.00e-02 *i*	5.71e-03 *a*			y	39	21	27	20000	1600
Chlorobenzilate	2.00e-02 *i*		2.70e-01 *h*	2.70e-01 *h*		0.25	0.023	0.012	11	2.4
p-Chlorobenzoic acid	2.00e-01 *h*					7300	730	270	200000	16000
4-Chlorobenzotrifluoride	2.00e-02 *h*					730	73	27	20000	1600
2-Chloro-1,3-butadiene	2.00e-02 *a*	2.00e-03 *h*			y	14	7.3	27	20000	1600
1-Chlorobutane	4.00e-01 *h*				y	2400	1500	540	410000	31000
Chloroethane	2.00e-02 *e*	2.86e+00 *i*			y	710	10000	27	20000	1600
2-Chloroethyl vinyl ether	2.50e-02 *o*				y	150	91	34	26000	2000
Chloroform	1.00e-02 *i*		6.10e-03 *i*	8.05e-02 *i*	y	0.15	0.078	0.52	470	100

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Chloromethane			1.30e-02 *h*	6.30e-03 *h*	y	1.4	0.99	0.24	220	49
4-Chloro-2-methylaniline			5.80e-01 *h*			0.12	0.011	0.0054	4.9	1.1
4-Chloro-2,2-methylaniline hydrochloride			4.60e-01 *h*			0.15	0.014	0.0069	6.2	1.4
beta-Chloronaphthalene	8.00e-02 *i*					2900	290	110	82000	6300
o-Chloronitrobenzene			2.50e-02 *h*		y	0.42	0.25	0.13	110	26
p-Chloronitrobenzene			1.80e-02 *h*		y	0.59	0.35	0.18	160	35
2-Chlorophenol	5.00e-03 *i*					180	18	6.8	5100	390
2-Chloropropane		2.86e-02 *h*			y	170	100			
Chlorothalonil	1.50e-02 *i*		1.10e-02 *h*			6.1	0.57	0.29	260	58
o-Chlorotoluene	2.00e-02 *i*				y	120	73	27	20000	1600
Chlorpropham	2.00e-01 *i*					7300	730	270	200000	16000
Chlorpyrifos	3.00e-03 *i*					110	11	4.1	3100	230
Chlorpyrifos-methyl	1.00e-02 *h*					370	37	14	10000	780
Chlorsulfuron	5.00e-02 *i*					1800	180	68	51000	3900
Chlorthiophos	8.00e-04 *h*					29	2.9	1.1	820	63
Chromium III and compounds	1.00e+00 *i*	5.71e-07 *y*				37000	0.0021	1400	1000000	78000
Chromium VI and compounds	5.00e-03 *i*			4.20e+01 *i*		180	0.00015	6.8	5100	390
Coal tar				2.20e+00 *y*			0.0028			
Coke Oven Emissions				2.17e+00 *i*			0.0029			
Copper and compounds	3.71e-02 *h*					1400	140	50	38000	2900
Crotonaldehyde	1.00e-02 *x*		1.90e+00 *h*	1.90e+00 *y*		0.035	0.0033	0.0017	1.5	0.34
Cumene	4.00e-02 *i*	2.57e-03 *h*				1500	9.4	54	41000	3100
Cyanazine	2.00e-03 *h*		8.40e-01 *h*			0.08	0.0075	0.0038	3.4	0.76
Cyanides										
Barium cyanide	1.00e-01 *h*					3700	370	140	100000	7800
Copper cyanide	5.00e-03 *i*					180	18	6.8	5100	390
Calcium cyanide	4.00e-02 *i*					1500	150	54	41000	3100
Cyanogen	4.00e-02 *i*					1500	150	54	41000	3100
Cyanogen bromide	9.00e-02 *i*					3300	330	120	92000	7000
Cyanogen chloride	5.00e-02 *i*					1800	180	68	51000	3900
Free cyanide	2.00e-02 *i*					730	73	27	20000	1600
Hydrogen cyanide	2.00e-02 *i*					730	73	27	20000	1600
Potassium cyanide	5.00e-02 *i*					1800	180	68	51000	3900
Potassium silver cyanide	2.00e-01 *i*					7300	730	270	200000	16000
Silver cyanide	1.00e-01 *i*					3700	370	140	100000	7800
Sodium cyanide	4.00e-02 *i*					1500	150	54	41000	3100
Zi[illegible]yanide	5.00e-02 *i*					1800	180	68	51000	3900

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
Cyclohexanone	5.00e+00 i				y	30000	18000	6800	1000000	390000
Cyclohexlamine	2.00e-01 i					7300	730	270	200000	16000
Cyhalothrin/Karate	5.00e-03 i					180	18	6.8	5100	390
Cypermethrin	1.00e-02 i					370	37	14	10000	780
Cyromazine	7.50e-03 i					270	27	10	7700	590
Dacthal	5.00e-01 i					18000	1800	680	510000	39000
Dalapon	3.00e-02 i					1100	110	41	31000	2300
Danitol	5.00e-04 x					18	1.8	0.68	510	39
DDD			2.40e-01 i			0.28	0.026	0.013	12	2.7
DDE			3.40e-01 i			0.2	0.018	0.0093	8.4	1.9
DDT	5.00e-04 i		3.40e-01 i	3.40e-01 i		0.2	0.018	0.0093	8.4	1.9
Decabromodiphenyl ether	1.00e-02 i				y	61	37	14	10000	780
Demeton	4.00e-05 i					1.5	0.15	0.054	41	3.1
Diallate			6.10e-02 h		y	0.17	0.1	0.052	47	10
Diazinon	9.00e-04 h					33	3.3	1.2	920	70
1,4-Dibromobenzene	1.00e-02 i				y	61	37	14	10000	780
Dibromochloromethane	2.00e-02 i		8.40e-02 i		y	0.13	0.075	0.038	34	7.6
1,2-Dibromo-3-chloropropane		5.71e-05 i	1.40e+00 h	6.90e-07 h	y	0.048	0.21	0.0023	2	0.46
1,2-Dibromoethane		5.71e-05 h	8.50e+01 i	7.70e-01 i	y	0.00075	0.0081	0.000037	0.034	0.0075
Dibutyl phthalate	1.00e-01 i					3700	370	140	100000	7800
Dicamba	3.00e-02 i					1100	110	41	31000	2300
1,2-Dichlorobenzene	9.00e-02 i	5.71e-02 a			y	370	210	120	92000	7000
1,3-Dichlorobenzene	8.90e-02 o				y	540	320	120	91000	7000
1,4-Dichlorobenzene		2.29e-01 h	2.40e-02 h		y	0.44	0.26	0.13	120	27
3,3*-Dichlorobenzidine			4.50e-01 i			0.15	0.014	0.007	6.4	1.4
1,4-Dichloro-2-butene				9.30e+00 h	y	0.0011	0.00067			
Dichlorodifluoromethane	2.00e-01 i	5.71e-02 a			y	390	210	270	200000	16000
1,1-Dichloroethane	1.00e-01 h	1.43e-01 a			y	810	520	140	100000	7800
1,2-Dichloroethane (EDC)		2.86e-03 e	9.10e-02 i	9.10e-02 i	y	0.12	0.069	0.035	31	7
1,1-Dichloroethylene	9.00e-03 i		6.00e-01 i	1.75e-01 i	y	0.044	0.036	0.0053	4.8	1.1
1,2-Dichloroethylene (cis)	1.00e-02 h				y	61	37	14	10000	780
1,2-Dichloroethylene (trans)	2.00e-02 i				y	120	73	27	20000	1600
1,2-Dichloroethylene (mixture)	9.00e-03 h				y	55	33	12	9200	700
2,4-Dichlorophenol	3.00e-03 i					110	11	4.1	3100	230
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	8.00e-03 i					290	29	11	8200	630
2,4-Dichlorophenoxyacetic Acid (2,4-D)	1.00e-02 i				y	61	37	14	10000	780

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
1,2-Dichloropropane		1.14e-03 *i*	6.80e-02 *h*		y	0.16	0.092	0.046	42	9.4
1,3-Dichloropropene	3.00e-04 *i*	5.71e-03 *i*	1.80e-01 *h*	1.30e-01 *h*	y	0.077	0.048	0.018	16	3.5
2,3-Dichloropropanol	3.00e-03 *i*					110	11	4.1	3100	230
Dichlorvos	8.00e-04 *x*		2.90e-01 *i*			0.23	0.022	0.011	9.9	2.2
Dicofol			4.40e-01 *x*			0.15	0.014	0.0072	6.5	1.5
Dicyclopentadiene	3.00e-02 *h*	5.71e-05 *a*			y	0.42	0.21	41	31000	2300
Dieldrin	5.00e-05 *i*		1.60e+01 *i*	1.61e+01 *i*		0.0042	0.00039	0.0002	0.18	0.04
Diesel emissions		1.43e-03 *i*				52	5.2			
Diethylene glycol, monobutyl ether		5.71e-03 *h*				210	21			
Diethylene glycol, monoethyl ether	2.00e+00 *h*					73000	7300	2700	1000000	160000
Diethylforamide	1.10e-02 *h*					400	40	15	11000	860
Di(2-ethylhexyl)adipate	6.00e-01 *i*		1.20e-03 *i*			56	5.2	2.6	2400	530
Diethyl phthalate	8.00e-01 *i*					29000	2900	1100	820000	63000
Diethylstilbestrol			4.70e+03 *h*			0.000014	0.0000013	0.00000067	0.00061	0.00014
Difenzoquat (Avenge)	8.00e-02 *i*					2900	290	110	82000	6300
Diflubenzuron	2.00e-02 *i*					730	73	27	20000	1600
Diisopropyl methylphosphonate (DIMP)	8.00e-02 *i*					2900	290	110	82000	6300
Dimethipin	2.00e-02 *i*					730	73	27	20000	1600
Dimethoate	2.00e-04 *i*					7.3	0.73	0.27	200	16
3,3'-Dimethoxybenzidine			1.40e-02 *h*			4.8	0.45	0.23	200	46
Dimethylamine		5.71e-06 *x*				0.21	0.021			
N-N-Dimethylaniline	2.00e-03 *i*					73	7.3	2.7	2000	160
2,4-Dimethylaniline			7.50e-01 *h*			0.09	0.0083	0.0042	3.8	0.85
2,4-Dimethylaniline hydrochloride			5.80e-01 *h*			0.12	0.011	0.0054	4.9	1.1
3,3'-Dimethylbenzidine			9.20e+00 *h*			0.0073	0.00068	0.00034	0.31	0.069
N,N-Dimethylformamide	1.00e-01 *h*	8.57e-03 *i*				3700	31	140	100000	7800
1,1-Dimethylhydrazine			2.60e+00 *h*	3.50e+00 *h*		0.026	0.0018	0.0012	1.1	0.25
1,2-Dimethylhydrazine			3.70e+01 *y*	3.70e+01 *y*		0.0018	0.00017	0.000085	0.077	0.017
2,4-Dimethylphenol	2.00e-02 *i*					730	73	27	20000	1600
2,6-Dimethylphenol	6.00e-04 *i*					22	2.2	0.81	610	47
3,4-Dimethylphenol	1.00e-03 *i*					37	3.7	1.4	1000	78
Dimethyl phthalate	1.00e+01 *h*					370000	37000	14000	1000000	780000
Dimethyl terephthalate	1.00e-01 *i*					3700	370	140	100000	7800
4,6-Dinitro-o-cyclohexyl phenol	2.00e-03 *i*					73	7.3	2.7	2000	160
1,2-Dinitrobenzene	4.00e-04 *h*					15	1.5	0.54	410	31
1,3-Dinitrobenzene	1.00e-04 *i*					3.7	0.37	0.14	100	7.8
1,4-Dinitrobenzene	4.00e-04 *h*					15	1.5	0.54	410	31

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
2,4-Dinitrophenol	2.00e-03 *i*					73	7.3	2.7	2000	160
Dinitrotoluene mixture			6.80e-01 *i*			0.099	0.0092	0.0046	4.2	0.94
2,4-Dinitrotoluene	2.00e-03 *i*					73	7.3	2.7	2000	160
2,6-Dinitrotoluene	1.00e-03 *h*					37	3.7	1.4	1000	78
Dinoseb	1.00e-03 *i*					37	3.7	1.4	1000	78
di-n-Octyl phthalate	2.00e-02 *h*					730	73	27	20000	1600
1,4-Dioxane			1.10e-02 *i*			6.1	0.57	0.29	260	58
Diphenamid	3.00e-02 *i*					1100	110	41	31000	2300
Diphenylamine	2.50e-02 *i*					910	91	34	26000	2000
1,2-Diphenylhydrazine			8.00e-01 *i*	7.70e-01 *i*		0.084	0.0081	0.0039	3.6	0.8
Diquat	2.20e-03 *i*					80	8	3	2200	170
Direct black 38			8.60e+00 *h*			0.0078	0.00073	0.00037	0.33	0.074
Direct blue 6			8.10e+00 *h*			0.0083	0.00077	0.00039	0.35	0.079
Direct brown 95			9.30e+00 *h*			0.0072	0.00067	0.00034	0.31	0.069
Disulfoton	4.00e-05 *i*					1.5	0.15	0.054	41	3.1
Diuron	2.00e-03 *i*					73	7.3	2.7	2000	160
1,4-Dithiane	1.00e-02 *i*					370	37	14	10000	780
Dodine	4.00e-03 *i*					150	15	5.4	4100	310
Endosulfan	6.00e-03 *h*					220	22	8.1	6100	470
Endothall	2.00e-02 *i*					730	73	27	20000	1600
Endrin	3.00e-04 *i*					11	1.1	0.41	310	23
Epichlorohydrin	2.00e-03 *h*	2.86e-04 *i*	9.90e-03 *i*	4.20e-03 *i*		6.8	1	0.32	290	65
1,2-Epoxybutane		5.71e-03 *i*				210	21			
EPTC (S-Ethyl dipropylthiocarbamate)	2.50e-02 *i*					910	91	34	26000	2000
Ethephon (2-chloroethyl phosphonic acid)	5.00e-03 *i*					180	18	6.8	5100	390
Ethion	5.00e-04 *i*					18	1.8	0.68	510	39
2-Ethoxyethanol	4.00e-01 *h*	5.71e-02 *i*				15000	210	540	410000	31000
2-Ethoxyethanol acetate	3.00e-01 *a*					11000	1100	410	310000	23000
Ethyl acetate	9.00e-01 *i*					33000	3300	1200	920000	70000
Ethyl acrylate			4.80e-02 *h*			1.4	0.13	0.066	60	13
Ethylbenzene	1.00e-01 *i*	2.86e-01 *i*			y	1300	1000	140	100000	7800
Ethylene cyanohydrin	3.00e-01 *h*					11000	1100	410	310000	23000
Ethylene diamine	2.00e-02 *h*					730	73	27	20000	1600
Ethylene glycol	2.00e+00 *i*					73000	7300	2700	1000000	160000
Ethylene glycol, monobutyl ether		5.71e-03 *h*				210	21			
Ethylene oxide			1.02e+00 *h*	3.50e-01 *h*		0.066	0.018	0.0031	2.8	0.63

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Ethylene thiourea (ETU)	8.00e-05 *i*		6.00e-01 *h*			0.11	0.01	0.0053	4.8	1.1
Ethyl ether	2.00e-01 *i*				y	1200	730	270	200000	16000
Ethyl methacrylate	9.00e-02 *h*					3300	330	120	92000	7000
Ethyl p-nitrophenyl phenylphosphorothioate	1.00e-05 *i*					0.37	0.037	0.014	10	0.78
Ethylnitrosourea			1.40e+02 *y*			0.00048	0.000045	0.000023	0.02	0.0046
Ethylphthalyl ethyl glycolate	3.00e+00 *i*					110000	11000	4100	1000000	230000
Express	8.00e-03 *i*					290	29	11	8200	630
Fenamiphos	2.50e-04 *i*					9.1	0.91	0.34	260	20
Fluometuron	1.30e-02 *i*					470	47	18	13000	1000
Fluoride	6.00e-02 *i*					2200	220	81	61000	4700
Fluoridone	8.00e-02 *i*					2900	290	110	82000	6300
Flurprimidol	2.00e-02 *i*					730	73	27	20000	1600
Flutolanil	6.00e-02 *i*					2200	220	81	61000	4700
Fluvalinate	1.00e-02 *i*					370	37	14	10000	780
Folpet	1.00e-01 *i*		3.50e-03 *i*			19	1.8	0.9	820	180
Fomesafen			1.90e-01 *i*			0.35	0.033	0.017	15	3.4
Fonofos	2.00e-03 *i*					73	7.3	2.7	2000	160
Formaldehyde	2.00e-01 *i*			4.55e-02 *i*		7300	0.14	270	200000	16000
Formic Acid	2.00e+00 *h*					73000	7300	2700	1000000	160000
Fosetyl-al	3.00e+00 *i*					110000	11000	4100	1000000	230000
Furan	1.00e-03 *i*					37	3.7	1.4	1000	78
Furazolidone			3.80e+00 *h*			0.018	0.0016	0.00083	0.75	0.17
Furfural	3.00e-03 *i*	1.43e-02 *a*				110	52	4.1	3100	230
Furium			5.00e+01 *h*			0.0013	0.00013	0.000063	0.057	0.013
Furmecyclox			3.00e-02 *i*			2.2	0.21	0.11	95	21
Glufosinate-ammonium	4.00e-04 *i*					15	1.5	0.54	410	31
Glycidaldehyde	4.00e-04 *i*	2.86e-04 *h*				15	1	0.54	410	31
Glyphosate	1.00e-01 *i*					3700	370	140	100000	7800
Haloxyfop-methyl	5.00e-05 *i*					1.8	0.18	0.068	51	3.9
Harmony	1.30e-02 *i*					470	47	18	13000	1000
Heptachlor	5.00e-04 *i*		4.50e+00 *i*	4.55e+00 *i*	y	0.0023	0.0014	0.0007	0.64	0.14
Heptachlor epoxide	1.30e-05 *i*		9.10e+00 *i*	9.10e+00 *i*	y	0.0012	0.00069	0.00035	0.31	0.07
Hexabromobenzene	2.00e-03 *i*				y	12	7.3	2.7	2000	160
Hexachlorobenzene	8.00e-04 *i*		1.60e+00 *i*	1.61e+00 *i*	y	0.0066	0.0039	0.002	1.8	0.4
Hexachlorobutadiene	2.00e-04 *h*		7.80e-02 *i*	7.70e-02 *i*	y	0.14	0.081	0.04	37	8.2
HCH (alpha)			6.30e+00 *i*	6.30e+00 *i*		0.011	0.00099	0.0005	0.45	0.1
HCH (beta)			1.80e+00 *i*	1.80e+00 *i*		0.037	0.0035	0.0018	1.6	0.35

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HCH (gamma) Lindane	3.00e-04 i		1.30e+00 h			0.052	0.0048	0.0024	2.2	0.49
HCH-technical			1.80e+00 i	1.79e+00 i		0.037	0.0035	0.0018	1.6	0.35
Hexachlorocyclopentadiene	7.00e-03 i	2.00e-05 h			y	0.15	0.073	9.5	7200	550
Hexachlorodibenzo-p-dioxin mixture (HxCDD)			6.20e+03 i	4.55e+03 i		0.000011	0.0000014	0.00000051	0.00046	0.0001
Hexachloroethane	1.00e-03 i		1.40e-02 i	1.40e-02 i	y	0.75	0.45	0.23	200	46
Hexachlorophene	3.00e-04 i					11	1.1	0.41	310	23
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	3.00e-03 i		1.10e-01 i			0.61	0.057	0.029	26	5.8
n-Hexane	6.00e-02 h	5.71e-02 i			y	350	210	81	61000	4700
Hexazinone	3.30e-02 i					1200	120	45	34000	2600
Hydrazine, hydrazine sulfate			3.00e+00 i	1.72e+01 i		0.022	0.00037	0.0011	0.95	0.21
Hydrogen chloride		2.00e-03 i				73	7.3			
Hydrogen sulfide	3.00e-03 i	2.57e-04 i				110	0.94	4.1	3100	230
Hydroquinone	4.00e-02 h					1500	150	54	41000	3100
Imazalil	1.30e-02 i					470	47	18	13000	1000
Imazaquin	2.50e-01 i					9100	910	340	260000	20000
Iprodione	4.00e-02 i					1500	150	54	41000	3100
Isobutanol	3.00e-01 i				y	1800	1100	410	310000	23000
Isophorone	2.00e-01 i		9.50e-04 i			71	6.6	3.3	3000	670
Isopropalin	1.50e-02 i					550	55	20	15000	1200
Isopropyl methyl phosphonic acid (IMPA)	1.00e-01 i					3700	370	140	100000	7800
Isoxaben	5.00e-02 i					1800	180	68	51000	3900
Kepone			1.80e+01 e			0.0037	0.00035	0.00018	0.16	0.035
Lactofen	2.00e-03 i					73	7.3	2.7	2000	160
Lead (tetraethyl)	1.00e-07 i					0.0037	0.00037	0.00014	0.1	0.0078
Linuron	2.00e-03 i					73	7.3	2.7	2000	160
Lithium	2.00e-02 e					730	73	27	20000	1600
Londax	2.00e-01 i					7300	730	270	200000	16000
Malathion	2.00e-02 i					730	73	27	20000	1600
Maleic anhydride	1.00e-01 i					3700	370	140	100000	7800
Maleic hydrazide	5.00e-01 i					18000	1800	680	510000	39000
Malononitrile	2.00e-05 h					0.73	0.073	0.027	20	1.6
Mancozeb	3.00e-02 h					1100	110	41	31000	2300
Maneb	5.00e-03 i					180	18	6.8	5100	390
Manganese and compounds	5.00e-03 i	1.14e-04 i				180	0.42	6.8	5100	390
Mephosfolan	9.00e-05 h					3.3	0.33	0.12	92	7

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
Mepiquat chloride	3.00e-02 *i*					1100	110	41	31000	2300
Mercury (methyl)	3.00e-04 *i*					11	1.1	0.41	310	23
Mercury (inorganic)	3.00e-04 *h*	8.57e-05 *h*				11	0.31	0.41	310	23
Merphos	3.00e-05 *i*					1.1	0.11	0.041	31	2.3
Merphos oxide	3.00e-05 *i*					1.1	0.11	0.041	31	2.3
Metalaxyl	6.00e-02 *i*					2200	220	81	61000	4700
Methacrylonitrile	1.00e-04 *i*	2.00e-04 *a*				3.7	0.73	0.14	100	7.8
Methamidophos	5.00e-05 *i*					1.8	0.18	0.068	51	3.9
Methanol	5.00e-01 *i*					18000	1800	680	510000	39000
Methidathion	1.00e-03 *i*					37	3.7	1.4	1000	78
Methomyl	2.50e-02 *i*					910	91	34	26000	2000
Methoxychlor	5.00e-03 *i*					180	18	6.8	5100	390
2-Methoxyethanol	1.00e-03 *h*	5.71e-03 *i*				37	21	1.4	1000	78
2-Methoxyethanol acetate	2.00e-03 *a*					73	7.3	2.7	2000	160
2-Methoxy-5-nitroaniline			4.60e-02 *h*			1.5	0.14	0.069	62	14
Methyl acetate	1.00e+00 *h*					37000	3700	1400	1000000	78000
Methyl acrylate	3.00e-02 *a*					1100	110	41	31000	2300
2-Methylaniline			2.40e-01 *h*			0.28	0.026	0.013	12	2.7
2-Methylaniline hydrochloride			1.80e-01 *h*			0.37	0.035	0.018	16	3.5
Methyl chlorocarbonate	1.00e+00 *x*					37000	3700	1400	1000000	78000
2-Methyl-4-chlorophenoxyacetic acid	5.00e-04 *i*					18	1.8	0.68	510	39
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)	1.00e-02 *i*					370	37	14	10000	780
2-(2-Methyl-4-chlorophenoxy) propionic acid	1.00e-03 *i*					37	3.7	1.4	1000	78
2-(2-Methyl-1,4-chlorophenoxy) propionic acid (MCPP)	1.00e-03 *i*					37	3.7	1.4	1000	78
Methylcyclohexane		8.57e-01 *h*				31000	3100			
4,4'-Methylenediphenyl isocyanate		5.71e-06 *h*			y	0.035	0.021			
4,4'-Methylenebisbenzeneamine			2.50e-01 *h*			0.27	0.025	0.013	11	2.6
4,4'-Methylene bis(2-chloroaniline)	7.00e-04 *h*		1.30e-01 *h*	1.30e-01 *h*		0.52	0.048	0.024	22	4.9
4,4'-Methylene bis(N,N'-dimethyl)aniline			4.60e-02 *i*			1.5	0.14	0.069	62	14
Methylene bromide	1.00e-02 *a*				y	61	37	14	10000	780
Methylene chloride	6.00e-02 *i*	8.57e-01 *h*	7.50e-03 *i*	1.65e-03 *i*	y	4.1	3.8	0.42	380	85
Methyl ethyl ketone	6.00e-01 *i*	2.86e-01 *i*				22000	1000	810	610000	47000
Methyl hydrazine			1.10e+00 *h*			0.061	0.0057	0.0029	2.6	0.58
Methyl isobutyl ketone	5.00e-02 *h*	2.29e-02 *a*				1800	83	68	51000	3900

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
Methyl methacrylate	8.00e-02 h					2900	290	110	82000	6300
2-Methyl-5-nitroaniline			3.30e-02 h			2	0.19	0.096	87	19
Methyl parathion	2.50e-04 i					9.1	0.91	0.34	260	20
2-Methylphenol (o-cresol)	5.00e-02 i					1800	180	68	51000	3900
3-Methylphenol (m-cresol)	5.00e-02 i					1800	180	68	51000	3900
4-Methylphenol (p-cresol)	5.00e-03 h					180	18	6.8	5100	390
Methyl styrene (mixture)	6.00e-03 a	1.14e-02 a			y	60	42	8.1	6100	470
Methyl styrene (alpha)	7.00e-02 a				y	430	260	95	72000	5500
Methyl tertbutyl ether (MTBE)	5.00e-03 e	8.57e-01 i			y	180	3100	6.8	5100	390
Metolaclor (Dual)	1.50e-01 i					5500	550	200	150000	12000
Metribuzin	2.50e-02 i					910	91	34	26000	2000
Mirex	2.00e-04 i		1.80e+00 h			0.037	0.0035	0.0018	1.6	0.35
Molinate	2.00e-03 i					73	7.3	2.7	2000	160
Molybdenum	5.00e-03 i					180	18	6.8	5100	390
Monochloramine	1.00e-01 i					3700	370	140	100000	7800
Naled	2.00e-03 i					73	7.3	2.7	2000	160
Napropamide	1.00e-01 i					3700	370	140	100000	7800
Nickel (soluble salts)	2.00e-02 i					730	73	27	20000	1600
Nickel refinery dust				8.40e-01 i			0.0075			
Nickel subsulfide				1.70e+00 i			0.0037			
Nitrapyrin	1.50e-03 x					55	5.5	2	1500	120
Nitrate	1.60e+00 i					58000	5800	2200	1000000	130000
Nitric Oxide	1.00e-01 i					3700	370	140	100000	7800
Nitrite	1.00e-01 i					3700	370	140	100000	7800
2-Nitroaniline	6.00e-05 y	5.71e-05 h				2.2	0.21	0.081	61	4.7
3-Nitroaniline	3.00e-03 o					110	11	4.1	3100	230
4-Nitroaniline	3.00e-03 o					110	11	4.1	3100	230
Nitrobenzene	5.00e-04 i	5.71e-04 a			y	3.4	2.1	0.68	510	39
Nitrofurantoin	7.00e-02 h					2600	260	95	72000	5500
Nitrofurazone			1.50e+00 h	9.40e+00 h		0.045	0.00067	0.0021	1.9	0.43
Nitrogen dioxide	1.00e+00 i					37000	3700	1400	1000000	78000
Nitroguanidine	1.00e-01 i					3700	370	140	100000	7800
4-Nitrophenol	6.20e-02 o					2300	230	84	63000	4800
2-Nitropropane		5.71e-03 i		9.40e+00 h		210	0.00067			
N-Nitrosodi-n-butylamine			5.40e+00 i	5.60e+00 i		0.012	0.0011	0.00058	0.53	0.12
N-Nitrosodiethanolamine			2.80e+00 i			0.024	0.0022	0.0011	1	0.23
N-Nitrosodiethylamine			1.50e+02 i	1.51e+02 i		0.00045	0.000042	0.000021	0.019	0.0043
N-Nitrosodimethylamine			5.10e+01 i	4.90e+01 i		0.0013	0.00013	0.000062	0.056	0.013

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N-Nitrosodiphenylamine			4.90e-03 *i*			14	1.3	0.64	580	130
N-Nitroso di-n-propylamine			7.00e+00 *i*			0.0096	0.00089	0.00045	0.41	0.091
N-Nitroso-N-methylethylamine			2.20e+01 *i*			0.0031	0.00028	0.00014	0.13	0.029
N-Nitrosopyrrolidine			2.10e+00 *i*	2.14e+00 *i*		0.032	0.0029	0.0015	1.4	0.3
m-Nitrotoluene	1.00e-02 *h*				y	61	37	14	10000	780
o-Nitrotoluene	1.00e-02 *h*				y	61	37	14	10000	780
p-Nitrotoluene	1.00e-02 *h*				y	61	37	14	10000	780
Norflurazon	4.00e-02 *i*					1500	150	54	41000	3100
NuStar	7.00e-04 *i*					26	2.6	0.95	720	55
Octabromodiphenyl ether	3.00e-03 *i*					110	11	4.1	3100	230
Octahydro-1357-tetranitro-1357-tetrazocine (HMX)	5.00e-02 *i*					1800	180	68	51000	3900
Octamethylpyrophosphoramide	2.00e-03 *h*					73	7.3	2.7	2000	160
Oryzalin	5.00e-02 *i*					1800	180	68	51000	3900
Oxadiazon	5.00e-03 *i*					180	18	6.8	5100	390
Oxamyl	2.50e-02 *i*					910	91	34	26000	2000
Oxyfluorfen	3.00e-03 *i*					110	11	4.1	3100	230
Paclobutrazol	1.30e-02 *i*					470	47	18	13000	1000
Paraquat	4.50e-03 *i*					160	16	6.1	4600	350
Parathion	6.00e-03 *h*					220	22	8.1	6100	470
Pebulate	5.00e-02 *h*					1800	180	68	51000	3900
Pendimethalin	4.00e-02 *i*					1500	150	54	41000	3100
Pentabromo-6-chloro cyclohexane			2.30e-02 *h*			2.9	0.27	0.14	120	28
Pentabromodiphenyl ether	2.00e-03 *i*					73	7.3	2.7	2000	160
Pentachlorobenzene	8.00e-04 *i*				y	4.9	2.9	1.1	820	63
Pentachloronitrobenzene	3.00e-03 *i*		2.60e-01 *h*		y	0.041	0.024	0.012	11	2.5
Pentachlorophenol	3.00e-02 *i*		1.20e-01 *i*			0.56	0.052	0.026	24	5.3
Permethrin	5.00e-02 *i*					1800	180	68	51000	3900
Phenmedipham	2.50e-01 *i*					9100	910	340	260000	20000
Phenol	6.00e-01 *i*					22000	2200	810	610000	47000
m-Phenylenediamine	6.00e-03 *i*					220	22	8.1	6100	470
o-Phenylenediamine	6.00e-03 *h*					220	22	8.1	6100	470
p-Phenylenediamine	1.90e-01 *h*					6900	690	260	190000	15000
Phenylmercuric acetate	8.00e-05 *i*					2.9	0.29	0.11	82	6.3
2-Phenylphenol			1.94e-03 *h*			35	3.2	1.6	1500	330
Phorate	2.00e-04 *h*					7.3	0.73	0.27	200	16
Phosmet	2.00e-02 *i*					730	73	27	20000	1600
Phosphine	3.00e-04 *i*	8.57e-06 *h*				11	0.031	0.41	310	23

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Phosphorus (white)	2.00e-05 *i*					0.73	0.073	0.027	20	1.6
p-Phthalic acid	1.00e+00 *h*					37000	3700	1400	1000000	78000
Phthalic anhydride	2.00e+00 *i*	3.43e-01 *h*				73000	1300	2700	1000000	160000
Picloram	7.00e-02 *i*					2600	260	95	72000	5500
Pirimiphos-methyl	1.00e-02 *i*					370	37	14	10000	780
Polybrominated biphenyls	7.00e-06 *h*		8.90e+00 *h*			0.0076	0.0007	0.00035	0.32	0.072
Polychlorinated biphenyls (PCBs)			7.70e+00 *i*			0.0087	0.00081	0.00041	0.37	0.083
Aroclor 1016	7.00e-05 *i*					2.6	0.26	0.095	72	5.5
Polychlorinated terphenyls (PCTs)			4.50e+00 *e*			0.015	0.0014	0.0007	0.64	0.14
Polynuclear aromatic hydrocarbons										
Acenaphthene	6.00e-02 *i*					2200	220	81	61000	4700
Anthracene	3.00e-01 *i*					11000	1100	410	310000	23000
Benz[a]anthracene			7.30e-01 *e*	6.10e-01 *e*		0.092	0.01	0.0043	3.9	0.87
Benzo[b]fluoranthene			7.30e-01 *e*	6.10e-01 *e*		0.092	0.01	0.0043	3.9	0.87
Benzo[k]fluoranthene			7.30e-02 *e*	6.10e-02 *e*		0.92	0.1	0.043	39	8.8
Benzo[a]pyrene			7.30e+00 *i*	6.10e+00 *h*		0.0092	0.001	0.00043	0.39	0.088
Chrysene			7.30e-03 *e*	6.10e-03 *e*		9.2	1	0.43	390	87
Dibenz[ah]anthracene			7.30e+00 *e*	6.10e+00 *e*		0.0092	0.001	0.00043	0.39	0.088
Fluoranthene	4.00e-02 *i*					1500	150	54	41000	3100
Fluorene	4.00e-02 *i*					1500	150	54	41000	3100
Indeno[1,2,3-cd]pyrene			7.30e-01 *e*	6.10e-01 *e*		0.092	0.01	0.0043	3.9	0.87
Naphthalene	4.00e-02 *y*					1500	150	54	41000	3100
Pyrene	3.00e-02 *i*					1100	110	41	31000	2300
Prochloraz	9.00e-03 *i*		1.50e-01 *i*			0.45	0.042	0.021	19	4.3
Profluralin	6.00e-03 *h*					220	22	8.1	6100	470
Prometon	1.50e-02 *i*					550	55	20	15000	1200
Prometryn	4.00e-03 *i*					150	15	5.4	4100	310
Pronamide	7.50e-02 *i*					2700	270	100	77000	5900
Propachlor	1.30e-02 *i*					470	47	18	13000	1000
Propanil	5.00e-03 *i*					180	18	6.8	5100	390
Propargite	2.00e-02 *i*					730	73	27	20000	1600
Propargyl alcohol	2.00e-03 *i*					73	7.3	2.7	2000	160
Propazine	2.00e-02 *i*					730	73	27	20000	1600
Propham	2.00e-02 *i*					730	73	27	20000	1600
Propiconazole	1.30e-02 *i*					470	47	18	13000	1000
Propylene glycol	2.00e+01 *h*					730000	73000	27000	1000000	1000000
Propylene glycol, monoethyl ether	7.00e-01 *h*					26000	2600	950	720000	55000

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Propylene glycol, monomethyl ether	7.00e-01 *h*	5.71e-01 *i*				26000	2100	950	720000	55000
Propylene oxide		8.57e-03 *i*	2.40e-01 *i*	1.30e-02 *i*		0.28	0.48	0.013	12	2.7
Pursuit	2.50e-01 *i*					9100	910	340	260000	20000
Pydrin	2.50e-02 *i*					910	91	34	26000	2000
Pyridine	1.00e-03 *i*					37	3.7	1.4	1000	78
Quinalphos	5.00e-04 *i*					18	1.8	0.68	510	39
Quinoline			1.20e+01 *h*			0.0056	0.00052	0.00026	0.24	0.053
Resmethrin	3.00e-02 *i*					1100	110	41	31000	2300
Ronnel	5.00e-02 *h*					1800	180	68	51000	3900
Rotenone	4.00e-03 *i*					150	15	5.4	4100	310
Savey	2.50e-02 *i*					910	91	34	26000	2000
Selenious Acid	5.00e-03 *i*					180	18	6.8	5100	390
Selenium	5.00e-03 *i*					180	18	6.8	5100	390
Selenourea	5.00e-03 *h*					180	18	6.8	5100	390
Sethoxydim	9.00e-02 *i*					3300	330	120	92000	7000
Silver and compounds	5.00e-03 *i*					180	18	6.8	5100	390
Simazine	5.00e-03 *i*		1.20e-01 *h*			0.56	0.052	0.026	24	5.3
Sodium azide	4.00e-03 *i*					150	15	5.4	4100	310
Sodium diethyldithiocarbamate	3.00e-02 *i*		2.70e-01 *h*			0.25	0.023	0.012	11	2.4
Sodium fluoroacetate	2.00e-05 *i*					0.73	0.073	0.027	20	1.6
Sodium metavanadate	1.00e-03 *h*					37	3.7	1.4	1000	78
Strontium, stable	6.00e-01 *i*					22000	2200	810	610000	47000
Strychnine	3.00e-04 *i*					11	1.1	0.41	310	23
Styrene	2.00e-01 *i*	2.86e-01 *i*			y	1600	1000	270	200000	16000
Systhane	2.50e-02 *i*					910	91	34	26000	2000
2,3,7,8-TCDD (dioxin)			1.50e+05 *h*	1.50e+05 *h*		0.00000045	0.000000042	0.000000021	0.000019	0.0000043
Tebuthiuron	7.00e-02 *i*					2600	260	95	72000	5500
Temephos	2.00e-02 *h*					730	73	27	20000	1600
Terbacil	1.30e-02 *i*					470	47	18	13000	1000
Terbufos	2.50e-05 *h*					0.91	0.091	0.034	26	2
Terbutryn	1.00e-03 *i*					37	3.7	1.4	1000	78
1,2,4,5-Tetrachlorobenzene	3.00e-04 *i*				y	1.8	1.1	0.41	310	23
1,1,1,2-Tetrachloroethane	3.00e-02 *i*		2.60e-02 *i*	2.59e-02 *i*	y	0.41	0.24	0.12	110	25
1,1,2,2-Tetrachloroethane			2.00e-01 *i*	2.03e-01 *i*	y	0.052	0.031	0.016	14	3.2
Tetrachloroethylene (PCE)	1.00e-02 *i*		5.20e-02 *e*	2.03e-03 *e*	y	1.1	3.1	0.061	55	12
2,3,4,6-Tetrachlorophenol	3.00e-02 *i*					1100	110	41	31000	2300
p,a,a,a-Tetrachlorotoluene			2.00e+01 *h*		y	0.00053	0.00031	0.00016	0.14	0.032

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Tetrachlorovinphos	3.00e-02 *i*		2.40e-02 *h*			2.8	0.26	0.13	120	27
Tetraethyldithiopyrophosphate	5.00e-04 *i*					18	1.8	0.68	510	39
Thallic oxide	7.00e-05 *h*					2.6	0.26	0.095	72	5.5
Thallium acetate	9.00e-05 *i*					3.3	0.33	0.12	92	7
Thallium carbonate	8.00e-05 *i*					2.9	0.29	0.11	82	6.3
Thallium chloride	8.00e-05 *i*					2.9	0.29	0.11	82	6.3
Thallium nitrate	9.00e-05 *i*					3.3	0.33	0.12	92	7
Thallium selenite	9.00e-05 *x*					3.3	0.33	0.12	92	7
Thallium sulfate	8.00e-05 *i*					2.9	0.29	0.11	82	6.3
Thiobencarb	1.00e-02 *i*					370	37	14	10000	780
2-(Thiocyanomethylthio)-benzothiazole (TCMTB)	3.00e-02 *h*					1100	110	41	31000	2300
Thiofanox	3.00e-04 *h*					11	1.1	0.41	310	23
Thiophanate-methyl	8.00e-02 *i*					2900	290	110	82000	6300
Thiram	5.00e-03 *i*					180	18	6.8	5100	390
Tin and compounds	6.00e-01 *h*					22000	2200	810	610000	47000
Toluene	2.00e-01 *i*	1.14e-01 *y*			y	750	420	270	200000	16000
Toluene-2,4-diamine			3.20e+00 *h*			0.021	0.002	0.00099	0.89	0.2
Toluene-2,5-diamine	6.00e-01 *h*					22000	2200	810	610000	47000
Toluene-2,6-diamine	2.00e-01 *h*					7300	730	270	200000	16000
p-Toluidine			1.90e-01 *h*			0.35	0.033	0.017	15	3.4
Toxaphene			1.10e+00 *i*	1.12e+00 *i*		0.061	0.0056	0.0029	2.6	0.58
Tralomethrin	7.50e-03 *i*					270	27	10	7700	590
Triallate	1.30e-02 *i*					470	47	18	13000	1000
Triasulfuron	1.00e-02 *i*					370	37	14	10000	780
1,2,4-Tribromobenzene	5.00e-03 *i*				y	30	18	6.8	5100	390
Tributyltin oxide (TBTO)	3.00e-05 *i*					1.1	0.11	0.041	31	2.3
2,4,6-Trichloroaniline			3.40e-02 *h*			2	0.18	0.093	84	19
2,4,6-Trichloroaniline hydrochloride			2.90e-02 *h*			2.3	0.22	0.11	99	22
1,2,4-Trichlorobenzene	1.00e-02 *i*	2.57e-03 *a*			y	18	9.4	14	10000	780
1,1,1-Trichloroethane	9.00e-02 *y*	2.86e-01 *y*			y	1300	1000	120	92000	7000
1,1,2-Trichloroethane	4.00e-03 *i*		5.70e-02 *i*	5.60e-02 *i*	y	0.19	0.11	0.055	50	11
Trichloroethylene (TCE)	6.00e-03 *e*		1.10e-02 *y*	6.00e-03 *e*	y	1.6	1	0.29	260	58
Trichlorofluoromethane	3.00e-01 *i*	2.00e-01 *a*			y	1300	730	410	310000	23000
2,4,5-Trichlorophenol	1.00e-01 *i*					3700	370	140	100000	7800
2,4,6-Trichlorophenol			1.10e-02 *i*	1.09e-02 *i*		6.1	0.58	0.29	260	58
2,4,5-Trichlorophenoxyacetic Acid	1.00e-02 *i*					370	37	14	10000	780

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Commercial/ industrial soil (mg/kg)	Residential soil (mg/kg)
2-(2,4,5-Trichlorophenoxy) propionic acid	8.00e-03 *i*					290	29	11	8200	630
1,1,2-Trichloropropane	5.00e-03 *i*				y	30	18	6.8	5100	390
1,2,3-Trichloropropane	6.00e-03 *i*				y	37	22	8.1	6100	470
1,2,3-TCP as carcinogen			2.70e+00 *e*		y	0.0039	0.0023	0.0012	1.1	0.24
1,2,3-Trichloropropene	5.00e-03 *h*				y	30	18	6.8	5100	390
1,1,2-Trichloro-1,2,2-trifluoroethane	3.00e+01 *i*	8.57e+00 *h*			y	59000	31000	41000	1000000	1000000
Tridiphane	3.00e-03 *i*					110	11	4.1	3100	230
Triethylamine		2.00e-03 *i*				73	7.3			
Trifluralin	7.50e-03 *i*		7.70e-03 *i*			8.7	0.81	0.41	370	83
Trimethyl phosphate			3.70e-02 *h*			1.8	0.17	0.085	77	17
1,3,5-Trinitrobenzene	5.00e-05 *i*					1.8	0.18	0.068	51	3.9
Trinitrophenylmethylnitramine	1.00e-02 *h*					370	37	14	10000	780
2,4,6-Trinitrotoluene	5.00e-04 *i*		3.00e-02 *i*			2.2	0.21	0.11	95	21
Uranium (soluble salts)	3.00e-03 *i*					110	11	4.1	3100	230
Vanadium	7.00e-03 *h*					260	26	9.5	7200	550
Vanadium pentoxide	9.00e-03 *i*					330	33	12	9200	700
Vanadium sulfate	2.00e-02 *h*					730	73	27	20000	1600
Vernam	1.00e-03 *i*					37	3.7	1.4	1000	78
Vinclozolin	2.50e-02 *i*					910	91	34	26000	2000
Vinyl acetate	1.00e+00 *h*	5.71e-02 *i*				37000	210	1400	1000000	78000
Vinyl bromide		8.57e-04 *i*			y	5.2	3.1			
Vinyl chloride			1.90e+00 *h*	3.00e-01 *h*	y	0.019	0.021	0.0017	1.5	0.34
Warfarin	3.00e-04 *i*					11	1.1	0.41	310	23
m-Xylene	2.00e+00 *h*	2.00e-01 *y*			y	1400	730	2700	1000000	160000
o-Xylene	2.00e+00 *h*	2.00e-01 *y*			y	1400	730	2700	1000000	160000
p-Xylene		8.57e-02 *y*			y	520	310			
Xylene (mixed)	2.00e+00 *i*				y	12000	7300	2700	1000000	160000
Zinc	3.00e-01 *i*					11000	1100	410	310000	23000
Zinc phosphide	3.00e-04 *i*					11	1.1	0.41	310	23
Zineb	5.00e-02 *i*					1800	180	68	51000	3900

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